MONTHLY WEATHER REVIEW,

JUNE, 1879.

(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to July 14th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 122 Signal Service stations and 12 Canadian stations, as telegraphed to this office; monthly journals and means 127 and 145 respectively, from the former; reports from 37 Sunset stations; 204 monthly registers from Voluntary Observers; 37 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers in, and the local Weather Services of, the States of Iowa and Missouri; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

Upon chart No. II is shown by the isobaric lines the general distribution of atmospheric pressure, as reduced to sea-level, for the month. The general pressure on the Atlantic and Gulf coasts has been normal or slightly below, while in the interior for the Lakes, Mississippi valley, Tennessee and Ohio valley it has been considerably above the normal, reaching nearly 0.05 above on the Upper Lakes. As might be expected, from the frequency of storm paths traversing it, the Northwest was somewhat below the normal. The Pacific coast averaged nearly 0.04 below.

The Local Barometric Ranges have been comparatively small, and have varied as follows: Pacific coast, 0.15 at San Diego to 0.40 at Roseburg, Or, and 0.56 at Red Bluff; Western Plateau, 0.57 at Winnemucca to 0.78 at Salt Lake; Rocky Mountains, 0.45 at Santa Fe to 0.67 at Virginia City; Summit of Pike's Peak, 0.31; Gulf States, 0.24 at Key West to 0.47 at Montgomery, 0.42 at Galveston and 0.58 at Corsicana; Atlantic States, 0.42 at Jacksonville, 0.41 at Cape Lookout, 0.75 at Cape May, 0.77 at Newport and 0.68 at Eastport, and in the interior, 0.55 at Augusta, 0.71 at Lynchburg, 0.88 at Albany; Summit of Mt. Washington, 0.85; Ohio valley and Tennessee, 0.86 at Columbus to 0.52 at Memphis; Lake region, 0.69 at Oswego to 1.07 at Milwaukee and 0.95 at Duluth; Northwest and Eastern Slope of Rocky Mountains, 0.71 at St. Paul to 1.15 at Breckenridge and 0.73 at Deadwood; 1 06 at North Platte, 0.96 at Dodge City and 0.89 at Fort Sill.

Areas of High Barometer.—Of these, four have been sufficiently marked to merit a description.

No. I.—The area described as No. IX in the *May Review* was central in Minnesota on the morning of the 1st; barometers at Bismarck 30.47, Breckenridge 30.39, or 0.50 above normal at each station—the highest barometer reported during the month. Moving nearly due south it was central over western Kansas on the morning of the 2nd. Its course thence was S-SW., being central in western Texas at midnight. By morning of the 3rd it had passed into Mexico. This area was accompanied by the minima temperatures for the month for the entire Rocky Mountain slope, Missouri and Rio Grande valleys, Western and Eastern Gulf, Tennessee, the western portion of Upper Lakes, Mississippi and Ohio valleys. A minimum temperature of 31° was reported at Pembina the morning of the 1st and at Cheyenne of 32° the 2nd. The maximum temperatures on these dates, of 96° at Boston on the 1st, 103°.5 at Los Angeles, 100° at Sacramento on the 2nd, and 109° at Visalia on the 3rd, in connection with low areas Nos. I and II, are especially noticeable. Frosts, not severe, were reported in Iowa on the 1st and 2nd, and ice an eighth of an inch thick in central Wisconsin on the 2nd, but no damage resulted to crops. The following high winds accompanied this area: On the 1st, Escanaba, 28 miles; Chicago, 26; Milwaukee, 25;

Cleveland, 25; Galveston, 28; 1st and 3rd, Indianola, 36 miles. Cautionary Signals were hoisted on the morning of the 2nd at New Orleans, Mobile and St. Marks, but are not justified by reports yet received, a maximum wind of 19 miles being reported from New Orleans. This area caused a severe "norther" in the Gulf of Mexico, from which four vessels were shipwrecked at or near Santa Ana, Mexico.

No. II.—This area, advancing from the Northwest, central at midnight of the 5th at Pembina, was north of Duluth on the morning of the 6th; Duluth barometer 0.28 above normal. Moving S. of E. on the morning of the 7th it was central over northern Michigan; Escanaba barometer 0.34 and Alpena 0.30 above normal. Thence moving SE. it was over Lake Erie the morning of the 8th; Erie and Cleveland barometers 0.28 above normal, and by midnight had passed off the Jersey coast. This area was accompanied by the minima temperatures for the month for eastern Michigan, Lower Lakes, eastern Ohio valley, Middle Atlantic and New England States, except Connecticut. The following minima were reported: 6th, Pembina, 32°; 7th, Parry Sound, 31°; 8th, Rockliffe, 32°. The 40° isotherm of minima temperatures included on the 6th northern Minnesota and northern Michigan; 7th, Michigan, parts of Wisconsin, northwestern Pennsylvania, western New York and northern portion of New England. Light snowstorms were reported from northern New England and Canada night of the 6th and morning of the 7th, injuring crops. On the 7th damaging frosts were reported from central Wisconsin and northern New England. Light frosts (6th–9th) were reported variously from Iowa, Michigan, Ohio and northern portions of Pennsylvania, New Jersey, New York and New England. Cautionary Signals were hoisted on the morning of the 6th on the Lower Lakes from Port Huron east to include Oswego, all of which were fully justified, the winds attaining velocities ranging from 25 miles at Buffalo to 32 at Toledo. Winds exceeding 25 miles, for which no signals were hoisted, were reported as follows: Morning of the 6th, Milwaukee, 29 miles; afternoon of 6th, Escanaba, 28; Alpena, 28. The advance of this area in conjunction with low area pressure No. II induced the very high winds experienced on the Middle Atlantic coast during the 6th, which are given in connection with that area.

No. III.—This area followed sharply the low area pressure No. IV, and showed itself central near Lake Winnepeg, Manitoba, the morning of the 16th; Duluth barometer 0.18 above the normal; by midnight the barometer was 0.32 above the normal at Duluth, north of which the pressure was then central. Moving slowly SE. it was central over Lake Superior during the 17th, and by the morning of the 18th was between Escanaba and Marquette; the barometers reading respectively 0.47 and 0.45 above the normal; the isobar of 0.40 above the normal then included parts of Minnesota and Michigan and all of Wisconsin. Keeping the same general direction, on the morning of the 19th it was central over the southern part of Lake Huron, and on the morning of the 20th in central Maryland; thence it moved south, with slowly diminishing pressure, passing off the Carolina coast on the morning of the 21st. The lowest minima temperatures reported were 16th, Marquette, 49°; 17th, Marquette, 37°; Escanaba, 38°; frosts in Wisconsin, Pennsylvania and Ohio; 18th, Saugeen 39°; frosts in New Jersey and Ohio; 19th, Saugeen, 38°; frosts in New York and Maine. The lowest temperatures for the month accompanied this area in Connecticut and in the South Atlantic States. In West Virginia frost was reported 60 miles west of Wytheville on the 19th and 20th. A portion of the Cautionary Signals (fully justified) which were hoisted for the low area pressure No. IV were lowered the morning of the 16th, somewhat early, as high winds from the high pressure continued at Escanaba afternoon 16th, 26 miles, Grand Haven 28, and 26 at midnight. Brisk winds were also reported at midnight on the Atlantic coast. Maxima: Sandy Hook, 28; Cape May, 26; and Cape Hatteras 25 miles. On the morning of the 17th Cautionary Signals were hoisted somewhat late on the North Carolina coast and Offshore on the Jersey coast. Maxima velocities had been reported at Cape Henry, 27 at Kittyhawk, 33 Cape Lookout, 25, and Cape May, 28 miles. The signals were lowered at noon on the Jersey coast, justified as to direction, with a velocity of 24 miles reported at Sandy Hook. The Carolina signals having been generally justified were lowered the afternoon of the 17th. Midnight maxima velocities of 28 miles at Sandy Hook and 25 at Cape Lookout were reported, followed by 28 miles at Cape Lookout and 26 at Cape Henry on the following morning. The winds continuing brisk on the Carolina coast, Cautionary Signals were hoisted on the morning of the 19th as far south as Cape Lookout, where a velocity of 30 miles preceding report and 28 at that time had been reported. These signals were lowered at midnight of the 20th, having been fully justified; NE. winds from 25 to 62 miles being reported from the various stations.

No. IV.—This area first appeared on the Southern Pacific coast the morning of the 22nd; Los Angeles barometer 0.03 above the normal. Its course was almost due north and by the morning of the 23rd the Red Bluff barometer was 0.23 above the normal. The rain in Oregon of the 21st, following low area No. VI, continued during the 22nd and 23rd, with fresh westerly winds, while fresh to brisk westerly, winds with no precipitation, were reported from California during the 22nd. By the morning of the 24th the centre had passed into British Columbia.

Areas of Low Barometer.—Upon chart No. I are shown the tracks of the centres of nine areas. The greater number of the storms have passed NE. through Dakota and Minnesota into Manitoba or Canada, and no centre has passed south of the Ohio valley. The maximum temperatures in New England and Middle Atlantic States occurred during the advance of low areas No. I on the 1st and 2nd, and No. VIII on the 27th to 30th. The advance of area No. VIII was also marked by the highest temperatures for the month in the Upper river valleys and the Lakes. In the Gulf and South Atlantic States the highest temperatures were reported during the progress of area No. IV.

No. I—is a continuation of low area No. XV, described in the *May Review*. Central in Indiana on the morning of the 1st it moved during the day northeastward reaching at midnight the St. Lawrence valley, whence its course east left its centre the morning of the 2nd on the Maine coast. At this time there was an elongated trough of low pressure extending from Nova Scotia to Alabama, between high area No. I and a probable high area off the South Atlantic coast, rain and fresh NW. winds in Tennessee and Ohio valley, fresh to brisk SW. winds with fine weather on the Middle and South Atlantic coasts. This trough, moving east, by the afternoon of the 2dd, had induced brisk winds on the North Carolina and New Jersey coasts, where Cautionary Signals were ordered from Sandy Hook to Cape Lookout, somewhat late for Cape May and Kittyhawk, where 28 and 27 miles had been respectively reported. Light rains along the Atlantic coast and the precipitation in advance of depression No. II kept the pressure nearly stationary during the 3rd, with continued brisk to high southerly winds, along the Carolina and Jersey coasts. On the 4th low area No. II changing its course to the NE. the wind changed to the NW. and permitted the lowering of the signals on the Jersey coast in the morning and on the Carolina coast in the afternoon. These signals were justified by velocities ranging from 25 to 32 miles.

No. II.—The centre of this area which was in Manitoba the morning of the 3rd, following a SE. course reached Duluth by midnight, where the barometer had fallen from 0.09 above the normal to 0.23 below. Light local rains prevailed during the day in Minnesota and Dakota. Its course was then east, passing over Lake Superior during the day, it was central at midnight of the 4th near Rockliffe. Heavy rains prevailed during the day in New England, and light rains in the Upper and Lower Lakes. During the forenoon of the 5th, the depression disappeared passing into the Gulf of St. Lawrence. No signals were ordered for the primary depression which generally showed little energy. A subsidiary area developing from the rear of the low trough on the 6th was, however, characterized by the highest winds of the month for the Canadian and New England coasts. The pressure rose rapidly in the St. Lawrence valley from morning to midnight of the 5th, (0.29 above a normal rise at Toronto,) leaving at midnight a small depression over Michigan (from 0.04 to 0.07 only below the normal,) with gentle to brisk winds, partly cloudy weather along the Lakes, light local rains to the Northwest, and heavy local rains in Pennsylvania, with clear fine weather in Ontario. On the morning of the 6th an abnormal barometric fall of 0.22 was reported from Toronto, and an abnormal rise of 0.24 at Escanaba—the advance of high area No. II. The increased depression then covered Lake Ontario over which the barometer was 0.20 below the normal. Cloudy weather then prevailed from Michigan east, to include New England, with brisk west and south winds in Lower Lake region and Missouri, and light local rains, except heavy rain at Pittsburgh. Cautionary Signals were at once ordered for Lakes Ontario and Erie in connection with this depression and high area No. II, which were justified as shown elsewhere. By the afternoon of the 6th the secondary depression following the course of the primary area was central over Maine, the Portland barometer reading 0.33 below the normal. An abnormal barometric fall of from 0.08 at Atlantic City to 0.21 at Portland, together with the rapid advance of high area No. II, had induced strong winds off the Maine, (max. 29 miles,) Carolina (max. 29 miles,) and Jersey coasts, with a maximum of 52 miles at Cape May. Cautionary Signals were ordered from Smithville along the coast northward to include Eastport, Me., and continued on the Jersey and Carolina coasts until the afternoon of the 7th, and were lowered at New England stations from midnight of the 6th to afternoon of the 7th, somewhat early for Boston and Portland. The Jersey coast signals were changed to Off-shore at midnight of the 6th, and Lewes and Eastport likewise changed on the morning of the 7th. These signals were all justified by succeeding N. to W. winds, of velocities ranging from 26 to 40 miles. By the morning of the 7th the storm was central in St. Lawrence Bay. Velocities of 55 and 50 miles were reported from Father Point at the morning and afternoon reports of the 7th, with a maximum velocity of 66 miles at 7 a. m. Several vessels were badly injured in the St. Lawrence river on the 7th, and one dismasted near Cape Ann in a squall the night of the 6th..

No. III.—This area first appeared on the 3rd on the South Pacific coast; the San Diego barometer at the afternoon report reading 0.10 below the normal, the isobar of 29.90 including all of southern California. Its course was north, and by midnight of the 4th it was central in the upper Sacramento valley. On the 5th, changing its course to the east, it was central at midnight in southwestern Idaho; the barometer yet being below the normal on the Central and North Pacific coast. Strong NW. winds and consequent damage to three vessels were reported off San Francisco. Passing through southern Idaho on the 6th its centre appeared to be in western Wyoming at midnight of the 6th. At this time the line of 0.20 below the normal included all of Colorado and the depression divided. Its southern edge, in passing through Utah, induced exceedingly high winds, a train being blown from the Utah Western track west of Salt Lake City on the afternoon of the 6th, killing one person and wounding one. The maximum velocity for the month occurred that day at Salt Lake City, 34 miles SE., and at Pioche 40 S. Following an ENE. course the main depression was central in western Dakota on the afternoon of the 7th. Bismarck barometer 0.32 below the normal, when brisk to high winds and partly cloudy weather were reported from the Northwest, Upper Missouri and Mississippi valleys. Cautionary Signals were ordered for Duluth, (late,) Marquette, Escanaba and Milwaukee, which were lowered on the 8th at Milwaukee, the rest on the 10th. They were not justified as the depression in Central Dakota at midnight of the 7th moved northward, and on the morning of the 8th had passed into Manitoba. The secondary depression commenced with this area during the 7th, passing over the main Rocky range, included by midnight all of Colorado and western Kansas in the isobar of 0.20 below the normal. During the 8th the area remained nearly stationary in Kansas,

but by the morning of the 9th was central in Nebraska, at which time there was a low barometric trough extending from northern Texas to the Canada line. The main centre traveling northeast was by midnight central near Duluth; barometer 0.40 below the normal, while violent wind, hail and rain-storms prevailed in Kansas, doing great damage. Hail-stones at Easton, Kansas, reported eleven inches in circumference, and at Wichita weighing twelve ounces. The wind at Leavenworth attained a velocity of 48 miles S., and 2.49 inches rain-fall in four hours and ten minutes, and 4.30 inches at St. Joseph in 24 hours, ending 3 p. m. the 9th were reported. The town of Delphi, Ottawa county, Kansas, reports 32 buildings destroyed, two persons fatally injured and fourteen others hurt. Hail-stones fell weighing from 12 to 14 ounces. Glasgow, Asheville, Lawrence, Stanton, Easton, Kickapoo and Beloit, Kansas, were also reported seriously damaged during same day by similar storms. Numerous thunder-storms were reported. During the day heavy rains fell in the Mississippi and Ohio valleys and on the Upper Lakes. On the morning of the 10th the centre was over Lake Superior and passed into Canada. Signals were hoisted at Alpena and for Lake Michigan at midnight of the 9th and lowered the morning of the 10th. They were justified, except Alpena

No. IV.—This depression appeared on the Oregon coast before the preceding area had entirely disappeared. Its course was SE. through Oregon, Idaho and Utah during the 10th and 11th, on which days moderate rains fell on Pacific coast as far south as Visalia, and over the Northern and Middle Plateau Districts During the 12th it moved slowly E. through northern Colorado; easterly winds and heavy rains prevailing in the Missouri valley. Central at midnight in western Kansas thence it followed a direction E. of N. during the 13th, and at midnight was east of Bismarck; barometer 0.29 below the normal. Cautionary Signals were then ordered for Lake Superior and part of Lake Michigan. On the morning of the 14th moving easterly it was central in Minnesota and in the afternoon in western Wisconsin; La Crosse barometer 0.50 below the normal, with the abnormal line of —0.40 including Minnesota, eastern Iowa, Wisconsin and part of Michigan, with heavy rains and brisk S. to E. winds. Signals had been ordered for the rest of Lake Michigan in the morning and followed for the remaining lake stations during the afternoon. These signals were ordered in ample time and were justified by wind ranging from 26 to 35 miles, except at Port Huron and Detroit, where, however, a NW. wind of 24 miles prevailed. Continuing its course S. of E. it was central over Lake Michigan the morning of the 15th; Milwaukee barometer 0.59 below the normal, the lowest reported during the month. The isobar of 0.50 below the normal at this time covered the greater part of the Upper Lakes. Brisk southerly winds then prevailed along the Middle Atlantic coast, and rainy weather was reported from Lower Lakes, New York and New England. At noon Cautionary Signals were ordered on the Atlantic coast from Eastport south to include Smithville. During the day heavy rains, with N. to E. winds, prevailed in New England, brisk southerly winds on the Middle Atlantic coast; while the wind on the Upper Lakes changing to N., with clearing weather, allowed the signals for Superior to be lowered, followed by the other lake signals on the morning of the 16th, when the storm-centre had reached Connecticut. The centre moved SE. off the coast the afternoon of the 16th, with brisk N. and NW. winds prevailing from Maine to South Carolina. Signals were then lowered on the Atlantic coast; all having been justified by velocities from 25 to 36 miles, except Eastport, where NE. 19 miles was reported.

No. V.—This area was at no time central in the United States. Central near Lake Winnepeg the morning of the 20th, it moved easterly and disappeared on the 21st, being probably NE. of Lake Superior that morning. Gentle to fresh southerly winds, with considerable rains, were reported from northern Texas to Lake Superior. The lowest barometer was reported from Pembina a. m. of 20th, 0.25 below the normal. No signals were ordered.

No. VI.—This area was first shown by the barometer falling below the normal on the North and Central Pacific coast on the 20th. Moving SE. during the 21st from NW. Oregon to central Idaho; Boisé barometer 0.31 below the normal at midnight; it was followed during that and the succeding day by fresh westerly winds and rain in Oregon. On the 22nd, following a nearly NE. course, it passed through northern Utah and Wyoming, and by morning of the 23rd was central in eastern Dakota, light rains having been reported in Montana and northwestern Dakota. Thence it moved NE., being central in NW. Minnesota at midnight of the 23rd, heavy rains and thunder-storms prevailing in its rear in the Northwest and Upper Missouri valley. At no time was any rain reported in front of its path. By the morning of the 24th it had passed into Manitoba.

No. VII.—This depression probably had a common origin with No. VI. Central on the afternoon of the 23rd in eastern Colorado. It moved slowly to the Northeast, and on the afternoon of the 24th was central in western Iowa; Omaha barometer 0.25 below the normal, and thence northerly by midnight to eastern Minnesota. Heavy rains were reported from the Mississippi and Missouri valleys, with brisk southerly winds from the Mississippi valley and Upper Lakes. By the morning of the 25th the storm-centre had passed NE. beyond our stations. No signals were ordered, and but one station (Alpena) reported a wind (26 miles) which would have justified a display.

No. VIII.—This area first appeared in northwestern Dakota on the afternoon of the 25th, and moving nearly easterly, was central east of Pembina, barometer 0.16 below the normal, followed by moderate rain-fall and fresh westerly winds in the Upper Missouri valley. During the 26th its course was nearly easterly, and on the morning of the 27th its centre was in Canada, north of Lake Huron, rain and fresh to brisk southerly winds having been reported in the preceding twenty-four hours from the Upper and Lower Lakes. During the 27th fresh to brisk S. to W. winds, with light rain fall, was reported from the Lower Lakes and

New England, while the course of the area through Canada is uncertain. On the morning of the 28th it was central in northern Vermont; Montreal barometer 0.32 below normal, at which time brisk SW. winds prevailed on Middle Atlantic coast, with generally clear weather, except rain on North Carolina coast. During the day heavy rains fell in the Middle Atlantic States, and a violent local storm was reported from Baltimore, where it did much damage. Cautionary Signals ordered at noon were lowered during the afternoon on the Carolina and Jersey coast. Though hoisted somewhat late for the Carolina coast, they were justified by winds ranging from 28 to 40 miles. The depression moved NE., becoming deeper, and on the morning of the 29th disappeared into the Gulf of St. Lawrence, the barometer at Sydney being 0.42 below the normal, while the abnormal line of —0.30, extending itself south to include the Jersey coast, brisk SW. winds continued on the Carolina coast. Cautionary Signals were hoisted on the morning of the 29th on the Carolina and Off-shore on the Jersey coast and lowered at midnight. The signals were justified by winds ranging from 29 to 36 miles.

No. IX.—This area appeared on the Middle Pacific coast on the morning of the 28th and following a course generally NE. crossed the northern parts of California, Nevada, Utah and Wyoming, reaching central Dakota the morning of the 30th. Thence its course was nearly north and at midnight of the 30th it was central in northwest Dakota, the barometer at Bismarck being at that time 0.36 below the normal. Its progress was marked by gentle winds without precipitation on the 28th. On the 29th light rains prevailed in northern Montana followed on the 30th by heavy rains in the Northwest and Upper Missouri valley with brisk to high southerly winds in the Upper Missouri and Mississippi valleys. Generally clear weather prevailed during the 30th on the Upper Lakes with brisk S. to E. winds not sufficient to require signals.

INTERNATIONAL METEOROLOGY.

Three charts of International Meteorology are issued with this *Review*; No. IV, and two for *November*, 1877, which are not numbered. On the first are laid down the tracks of centres of low barometers and drawn the lines of equal precipitation. On the second are charted the lines of mean pressure and temperature and the force and prevailing direction of the wind at 7:35 a. m., Washington mean time, for that month. The two charts are based on the daily charts of the International Bulletin.

On chart No. IV are shown the probable tracks of storm-centres over the oceans, deduced from data received at this office up to July 3rd, and in the upper right-hand corner will be found an index to the same. The following is a brief notice of the same, and also of some storms over the Southern Hemisphere:

North Atlantic Ocean.—No. I probably developed on *April* 23rd about 55° N., 40° W.; it was attended by westerly gales and high seas from the 24th to the 26th between 35° and 15° W. and 45° and 55° N., and on latter day moved southeastward off the Irish coast towards France. No. II probably developed over the Bay of Biscay on *May* 1st, after which it moved eastward over the Mediterranean. No. III appeared on the coast of Portugal on *May* 7th. No. IV appeared to the northwestward of Ireland on *May* 16th and afterward moved southeastward over Europe. No. V is a continuation of low pressure area No. X described in the *May Review*. No. VI developed on *May* 21st and 22d in the southern extremity of low pressure area No. VIII described in *May Review;* on the 23rd it moved northeastward between the Atlantic coast and the Bermudas, attended by heavy rains over latter, and possibly joined the preceding area on the 26th in the neighborhood of Newfoundland. No. VII advanced toward the British Isles from the northwest on *May* 24th and moved as shown on chart. From the 27th of *April* to the end of *May* high pressures prevailed over the North Atlantic between latitudes 40 and 55, with almost an entire absence of high winds, excepting occasional gales attending the storms already noticed. *South Atlantic Ocean.*—Ship Ferris S. Thompson, from San Francisco, 114 days to New York, June 15th, reported *April* 17th, 1879, passed Cape Horn; 18th, 3 a. m., heavy SE. gale; first officer washed overboard and drowned; bulwarks badly stove. Bark Lepanto (from Melbourne to New York) passed Cape Horn *April* 25th, 1879, and on the 27th had a strong gale from SSE. to SSW., with b inding snow-storm, lasting 20 hours. *North Pacific Ocean.*—Five tracks are given on the chart, which probably indicate, somewhat correctly, the movement of the principal areas of low pressure, over the region covered, from *March* 28th to *April* 21st, 1879. *Indian Ocean.*—"*February* 12th, 1879, 41° 23′ S., 64° 48′ E., N. strong, heavy cross sea; 13th, 39° 46′ S., 63° 53′ E., W. strong, squally, heavy sea, shipped much water; 21st, 33° 08′ S., 45° 32′ E., SE. to ENE., heavy gales, cross sea and rain; 22nd, 31° 32′ S., 45° 16′ E., SE. to calm to NNW., heavy gales, heavy sea. A special account published in "*La Nature*" of the cyclone of *March* 19th, noticed in the *May Review*, will be found under "Notes and Extracts."

TEMPERATURE OF THE AIR.

The isothermal lines on chart No. II show the general distribution of the temperature of the air for the month. By a reference to the table of average temperatures upon the same chart it will be seen that the temperature of the present month has been very generally about normal or below the average, except in Missouri valley, Middle and southeast Rocky Mountain Slope, where it has been from 15° to 27° above. On the immediate North Pacific coast, and in the St. Lawrence valley, it has been from 3° to 3.5° below. The Salt Lake temperature is erroneously reported as *above* on chart No. II. It should read *below*. The following comments on the temperature for the month have been received from special observers: Gardiner, Me.,

extremely cold and very wet month, 3° below mean of 43 years; rain-fall in excess, 3.76 inches. Contoocookville, N. H., temperature 2° below average for 10 years; excess of rain about 2.25 inches. Westborough, Mass., "a cold, frosty month." Palermo, N. Y., coldest June since 1859. Riley, Ill., present month 1°.9 below month for 18 Junes past. Coalville, Utah, month 1°.5 colder than average June for 15 years; June 24th was 3° lower than any day in June during that period.

Minimum and Maximum Temperatures are, respectively, as follows:—*Maine*—at Portland, 44°, 93°; Orono, 34°, 87°. *New Hampshire*—Dumbarton, 40°, 92; Auburn, 32°, 92°; Mt. Washington, 15°, 70°. *Vermont* West Charlotte, 43°, 93°; Lunenburg, 34°, 87°; Woodstock, 32°, 92°. *Massachusetts*—Newburyport, 42°, 97°; Boston, 45°, 96°; Waltham, 40°, 91°. *Rhode Island*—Newport, 49°, 79°. *Connecticut*—New Haven, 46°, 90°; Southington, 44°, 87°. *New York*—Willet's Point, 46°, 97°; New York City, 47°, 89°; Plattsburg Barracks, 33°, 84°; Rochester, 36°, 91°; West Point, 45°, 100°. *Pennsylvania*—Milton, 47°, 98°; Franklin, 28°, 88°; Philadelphia, 49°, 93°; Pittsburgh, 39°, 94°; Erie, 42°, 88° *New Jersey*—Atco, 50°, 98°; Vineland, 44°, 94°; Priceton, 42°,—. *Maryland*—Woodstock, 45°, 94°; Baltimore, 52°, 94°. *Virginia*—Wytheville, 45°, 86°; Dover Mines, 55°, 98°; Norfolk, 55°, 96°. *West Virginia*—Morgantown, 39°, 88°. *North Carolina*—Summit of Roan Mountain, (Elevation 6,367 feet) 42°, 68°; Highlands, 44°, 88°; Weldon, 62°, 98°; Greensboro, 60°, 88°. *South Carolina*—Charleston, 60°, 92°. *Georgia*—McPherson Barracks, 50°, 96°; Savannah, 61°, 96°; Atlanta, 54°, 92°. *Florida*—Middleton, 56°, 94°; Ft. Barrancas, 60°, 102°; Jacksonville, 62°, 96°. *Alabama*—Green Springs, 54°, 88°; Montgomery, 58°, 98°; Mobile, 61°, 96°. *Mississippi*—Vicksburg, 53°, 96°; Fayette, 5°, 90°. *Louisiana*—Shreveport, 56°, 96°; New Orleans, 61°, 91°. *Texas*—Corsicana, 51°, 99°; Mason, 46°, 99°; Galveston, 64°, 94°; Laredo, 56°, 108°; Uvalde, 51°, 104°; Rio Grand City, 100° to 103°, from 12th to 16th, Graham, 44°, 105°; Edinburg, 105°, 14th; El Paso, 57°, 104°. *Ohio*—Westerville, 39°, 93°; Ruggles, 42°, 100°; Cincinnati, 53°, 90°; Toledo, 43°, 91°. *Indiana*—Spiceland, 43°, 90°; Vevay, 58°, 93°; Indianapolis, 47°, 91°. *Illinois*—Riley, 39°, 87°; Stirling, 49°, 94°; Chicago, 43°, 87°; Cairo, 53°, 91°. *Kentucky*—Louisville, 53°, 94°. *Tennessee*—Knoxville, 48°, 92; Memphis, 54°, 97°. *Arkansas*—Mt. Ida, 42°, 96°. *Missouri*—Pierce City, 38°, 98°; St. Louis, 50°, 95°; Kansas City, 45°, 96°. *Iowa*—Nora Springs, 40°, 92°; Logan, 44°, 92°; Des Moines, 45°, 90°; Keokuk, 47°, 89°. *Nebraska*—Ft. Sidney, 29°, 99°; Genoa, 47°, 99°; Omaha, 45°, 93°; Ft. McPherson, 36°, 99°. *Kansas*—Wellington, 45°, 98; Ft. Wallace, 52°, 108°; Leavenworth, 46°, 93°. *Indian Territory*—Ft. Sill, 47°, 98°; Ft. Gibson, 47°, 100°. *Michigan*—Marquette, 32, 95°; Port Huron, 39°, 90°; Lansing, 45°, 92°. *Minnesota*—Duluth, 39°, 85°; St. Paul, 44°, 91°; Breckenridge, 39°, 92°. *Wisconsin*—Neillsville, 35°, 91°; Milwaukee, 40°,85°; La Crosse, 43°, 88°. *Washington Territory*—Olympia, 38°, 76°. *Oregon*—Roseburg, 41°, 84°; Umatilla, 46°, 91°. *California*—Visalia, 46°, 109°; San Diego, 52°, 93°; Red Bluff, 55°, 104°; Los Angeles, 50°, 103°. *Nevada*—Winnemucca, 31°, 94°; Pioche 37°, 91°. *Colorado*—Pikes Peak, 12°, 52°; Denver, 43°, 95°; Hermosa, 42°, 92°. *Utah*—Coalville, 28°, 90°; St. George, —, 101°; Salt Lake City, 42°, 94°; Ft. Douglass, 40°, 93°. *New Mexico*—Ft. Union, 32°, 88°; Santa Fe, 38, 91°; Albuquerque, 80°, 102; La Messilla.—, 103°. *Arizona*—Camp Apache, 42°, 93°; Yuma, 59°, 101°; Wickenburg, 50°,103°; Camp McDowell, 45°, 110°; Florence, 56°, 110°. *Idaho*—Boise City, 41°, 93°. *Wyoming*—Cheyenne, 32°, 92°. *Dakota*—Pembina, 31°, 93; Bismarck, 36°, 91°; Yankton, 38°, 92°. *Montana*—Virginia City, 35°, 82°.

***Ranges** of Temperature.*—The *monthly ranges* will appear from an examination of the minima and maxima just given. The greatest *daily ranges* vary in New England from 17° at Wood's Holl to 36° at Boston; Middle Atlantic States, 18° at Cape May to 30° at Norfolk and Baltimore; South Atlantic States, 14° at Cape Lookout to 28° at Wilmington and Augusta; Eastern Gulf States, 19° at Key West to 29° at Montgomery; Western Gulf States, 16° at New Orleans and Galveston to 40 at Corsicana; Ohio valley and Tennessee, 24° at Cairo to 35° at Pittsburgh; Lower Lake region, 24° at Buffalo and Erie to 38° at Rochester; Upper Lake region, 26° at Chicago and Grand Haven to 44° at Marquette; Upper Mississippi valley, 25° at La Crosse to 38° at Keokuk; Missouri valley, 32° at Leavenworth to 42° at Yankton; Red River of the North valley, 35° at Breckenridge to 46° at Pembina; Eastern Rocky Mountain Slope, 33° at San Antonio to 45° at Uvalde and 43° at North Platte; Rocky Mountain stations, 22° at Pike's Peak to 39° at Denver and 44° at Cheyenne; Western Plateau, 32° at Pioche and 37° at Boise City to 43° at Winnemucca; California, 23° at San Francisco to 47° at Visalia; Oregon, 28° at Portland to 41° at Umatilla; Arizona, 43° at Yuma 47° at Tucson; Washington Territory, 32° at Olympia.

Frosts, injurious to vegetation, are reported as follows: Milwaukee, Wis., 7th, very destructive, vegetables and flowering plants extensively injured; Grand Haven, Mich., 7th, much damage to crops and small fruit; Oswego, N. Y., 7th, much damage reported throughout interior of State; Strafford, W., 7th, 8th, killed corn, potatoes and grapes; Logansport, Md., 7th, severe, injuring vegetation in southern part of country; Burlington, Vt., 13th, much damage done to crops in northern Vermont—in some places fruit ruined; Mt. Desert, Me., 9th, heavy, killing vegetation; New Bedford, Mass., 16th, lima beans touched; Westborough, Mass., 19th, enough to touch beans; Thornville, Mich., 7th, killing some corn and potatoes; Wautoma, Wis., 17th, heavy, killing corn, beans and potatoes, and doing some damage to all kinds of vines; 9th, Coalville, Utah, severe, every bush, bean and potato top cut down; 24th, potato tops all frozen black; everything looks desolate for crops.

Ground Frozen.—Burlington, Vt., 13th, to a depth of 1 inch.

Ice—formed at Nile, N. Y., on the 7th, one inch thick; at Neillsville, Wis., on the 2nd, ¼ inch thick.

PRECIPITATION.

The general distribution of the rain-fall for the month is illustrated as accurately as possible by returns from about 500 stations upon chart No. III. In the lower left-hand corner of the chart is a table giving, by districts, the average precipitation for June. The excess of rainfall over the average for a number of years has been greatest in the St. Lawrence valley, New England and the Lower Mississippi valley. The greatest defiiciency occurs in Tennessee, the Gulf and South Atlantic States over which region numerous cases of drought are reported, which will be noticed under the appropiate heading.

Heavy Rains.—2nd and 3rd, Hulmeville, Pa., 3.10 in.; Fall River, Mass., 1.92 in. in 1 hour. 3rd' Mystic, Conn., 2.50 in.; New London, 2.50 in. 3rd and 4th, Dover, Del., 2.80 in.; Auburn, N. H.. 3 in. 4th, Trenton, N. J., 2.80 in.; Atco, N. J., 3.23 in.; Fall River, Mass., 2 80 in. 5th, Trenton, N. J., 2 in. in 1 hour and 30 minutes. 8th, Savannah, 3.22 in., (2 in. in 50 minutes.) 9th, St. Marks, Fla., 5.24 in.; Leavenworth, 2.49 in.; Independence, Iowa, 3.06 in. 9th and 10th, Gainesville, Ga., 3.50 in. 10th, Vevay, Ind., 1.35 in. in 1 hour and 30 minutes; Kansas City, Mo., 1.56 in. in 45 minutes; St. Joseph, Mo., 4.30 in. 12th and 13th, Bismarck, Dak., 3.43 in.; Watervilie, Kan., 2.80 in.; Taber, Iowa, 2.90 in.; Clear Creek, Neb., 3.01 in., (2 in. in 25 minutes.) 15th, Lynchburg, Va., 1.02 in. in 20 minutes. 19th and 20th, Central City, Neb., 2.50 in. 21st, Fort Griffin, Tex., 10.24 in.; Fort Concho, 2.60 in. 24th, Des Moines, Iowa, 4.80 in., (2.50 in. in 20 minutes.) 26th, Boonville, Mo., 2.80 in.; Brunswick, Mo., 2.50 in.; Dodge City, Kan., 1.91 in. in 90 minutes. 27th, Leavenworth, 3.43 in.; Lexington, Mo., 3.30 in. in about 9 hours; Cresswell, Kan., 3.50 in. 27th and 28th, Cairo, Ill., 4.97 in., (3 in. in 90 minutes;) Anna, Ill., 3.28 in.; Kansas City, 2.62 in. 28th and 29th, Clinton, Mass., 2.99 in. 28th, Norwalk, Ohio, 2.45 in.; Little Rock, Ark., 7.40 in. 29th, Atlanta, Ga., 2.23 in.; Boston, 2 in., in 30 minutes; Southington, Conn., 1.45 in. in 15 minutes. 28th and 29th, Fort Barrancas, Fla., 4.82 in.

Largest Monthly Rainfalls.—Ft. Barancas, Fla., 10.49 inches; Kansas City, Mo., 9.02; Cairo, Ill., 8.70; St. Marks, Fla., 8.60; Trenton, N. J., 8.58; Manhatton, Kan., 8.48; Dunbarton, N. H., 8.45; Auburn, N. H., 8.41; Holton, Kan., 8.25; Rome, Mass., 7.90; New Corydon, Ind., 7.33; Anna, Ill., 7.02; In Iowa, at Jefferson City, Madison Co., 8.78 inches; near Corydon, Wayne County, 8.43 inches; and Mt. Pleasant, Henry Co., 8.18 inches.

Smallest Monthly Rainfalls.—Burkes and Florence, Ariz., Yuma, Cal., Emory Grove, Md., Yorktown, Tex., Coalville, Utah, none; Calistoga, Cal., Albuquerque, N. M., Ft. Lyon, Col., trace; Port San Jose, Cal., 0.02 in.; Los Angeles, Cal., 0.03 in.; Pilot Point, Tex., 0.04 in; Hermosa, Col., 0.06 in; Cheyenne, Wyoming, 0.07 in; Salinas City, Cal., 0.15 in; Umatilla, Or., 0.28 in; Denver, Col., 0.32 in; Olympia, W. T., 0. 44 in.

Rainy Days.—The number of days on which rain or snow has fallen varies as follows: New England, 11 to 20; Middle Atlantic States, 7 to 17; South Atlantic States, 5 to 14; Gulf States, 5 to 15; Lower Lakes, 12 to 18; Upper Lakes, 6 to 15; Ohio valley and Tennessee, 9 to 15; Upper Mississippi valley, 11 to 17; Lower Missouri valley, 12 to 13; Eastern Slope, from 7 in Indian Territory, to 18 in Western Dakota; Rocky Mountains, from 3 at Denver to 19 at Virginia City; Western Plateau, 5 to 13; Pacific Coast, 1 to 7.

Cloudy Days.—For New England the number varies from 6 to 17; Middle Atlantic States, 3 to 11; South Atlantic States, 1 to 9; Gulf States, 0 to 10; Lower Lakes, 6 to 12; Upper Lakes, 5 to 13; Ohio valley and Tennessee, 1 to 10; Upper Mississippi valley, 6 to 13; Lower Missouri valley, 5 to 8; Eastern Slope, 2 to 9; Rocky Mountains, 0 at Denver and Santa Fé to 15 at Virginia City; Western Plateau, 2 to 9; Pacific coast, 0 to 8.

Hail.—Ft. Hale, Dak., 5th; Ft. Wallace, Kan., 7th, 19th, 29th; Ft. Snelling, Minn., 9th; Ft. McPherson, Neb., 7th, 13th, 25th; Ft. Union, N. M., 1st; Dover Mines, Va., 19th, 3.30 p. m., terrific storm moved from NNW. to SSE., lasting 3 minutes, covering ground to the depth of ½ in.; diameter of stones one-half inch; area over which hail fell, 3 miles; gardens and fruit trees greatly damaged; Leavenworth, Kan., 9th, very heavy; 5th, terrific at West Newton, McKeesport, Library, Parker and other neighboring places in Pa.; Yankton, Dak., 5th, fell on prairie a few miles west of this place; reached an average depth of one foot, while on opposite side of river from there it was 9 inches deep; the path was from SW. to NE., about two miles wide; all crops in its track destroyed; largest stones one-half inch in diameter; Pioche, Nev., 12th; Santa Fe, N. M., 1st; Omaha, Neb., 8th, 10th, 14th; North Platte, Neb., 7th, 25th; Salt Lake City, Utah, 12th; Leavenworth, Kan., 8th, 9th, 11th, 14th; Deadwood, Dak., 30th; Yankton, Dak., 5th; Davenport, Ia., 2nd; Burlington, Ia., 14th; Pembina, Dak., 23rd; St. Paul, Minn., 9th; Breckenridge, Minn., 24th: Cleveland, O., 5th; Cincinnati, O., 10th; Philadelphia, 5th; Baltimore, 11th; Burlington, Vt., 4th, 10th; Boston, 29th; Springfield, Mass., 10th, 29th; Ft. Lyon, Col., 26th; Southington, Conn., 29th; Elmira, Ill., 2nd; Vevay, Ind., 10th; Spiceland, Ind., 3rd, 10th; St. Meinrad, Ind., 10th; Monticello, Ia., 3rd; Independence, Ia., 9th; Holton, Kan., 11th; Creswell, Kan., 9th; Woodstock, Md., 11th; Owings Mills, Md., 6th; Waltham, Mass., 5th; Hudson, Mich., 5th; Oregon, Mo., 13th; Kansas City, Mo., 10th; Clear Creek, Neb., 12th, 25th; Genoa, Neb., 10th; Contoocookville, N. H., 30th; Atco, N. J., 5th; Vineland, N. J., 5th; Somerville, N. J., 11th; Argyle, N. Y., 30th; Palermo, N. Y., 4th; Nile, N.

Y., 26th; Bellefontaine, O., 3rd; Cincinnati, 10th; Ringgold, O., 10th; North Lewisburg, O., 5th, 27th; Norwalk, O., 5th; Herman, Mo., 14th, severe hail storm, course from W. to E., about a mile in width, destroying three-fourths of the crops, uprooting trees, and blowing over a large log barn, stones 1½ inch in diameter fell, some vineyards entirely destroyed; 7th, the hail storm throughout northeastern and central Ohio was more severe than ever known in Delaware county, a perfect torrent of hail, breaking windows and doing other damages, hail was as large as hens eggs; 6th, New Market, Frederick Co., Md., "this neighborhood has again been visited by a most disastrous hail-storm, commencing this afternoon about 1½ o'clock. The wheat crop, in a belt at least half a mile in width and extending four or five miles in length, is nearly all destroyed."

Snow from Cloudless Sky.—Summit, Col., 16th.

Snow fell as follows: Winnemucca, Nev., 16th, heavy. Pike's Peak, 1st, 2nd, 13th, 14th, 15th, 16th, 27th and 28th. Fort Douglass, Utah, 7th, on Wasatch and Ogwoh ranges this a. m. Summit Station, Central Pacific R. R., 14th and 16th.

Depth of Snow on Ground at end of Month.—Pikes Peak, Col., the old snow is melting rapidly and the trail is open for horses to within 100 yards of the station.

Drought.—Summit, Col., 14th, first rainfall of 1879. Gulf Hammock, Fla., 30th, still suffering for rain; ground parceed; corn crop injured very much. Forsyth, Ga., 30th, water-courses very low; springs and wells failing; corn and cotton seriously damaged by drought. Thomasville, Ga., 30th, corn injured by drought. Okalooska, La., 30th, corn crop seriously injured by drought. Fallston, Md., 30th, gardens and crops suffering from drought. Emory Grove, Md., no rain during month. Northport, Mich., month very dry, injuring vegetation. Brookhaven, Miss., 26th, very dry; corn suffering. Fayette, Miss., 30th, early corn injured by drought. Fayetteville, N. C., 30th, everything suffering, and in many places vegetables and plants dying. Ringgold, Ohio, 30th, potatoes injured by drought. North Lewisburg, Ohio, very dry month. Chambersburg, Pa., 30th, oats and hay injured by drought. Clarksville, Tex., no rain from May 5th to June 15th; corn and oats suffered considerably. Melissa, Tex, 14th, long drought of six weeks, doing much damage to crops. Coalville, Utah, no rain during month; 6th, "terribly drying wind giving us notice of no crops this year; dust everywhere." Ft. Gibson, Ind. Ter., 19th, drought, vegetation checked, wells drying up. Chattanooga, Tenn., 1st, much damage done to garden products by drought. Augusta, Ga., 25th, "drought is beginning to tell fearfully on crops, especially corn, cotton and fruit; water melon vines drying by the acre—crop reported ruined." Stoop Point, N. C., 16th, drought continues. very severe. Graham, Tex., 8th, corn suffering greatly; 17th, corn crop an entire failure. Corsicana, Tex., 25th, farmers report very dry weather in adjoining counties; stock suffering. Portsmouth, N. C., 12th, 20th, water for stock very scarce. Kanab, Utah, 3rd to 19th; cattle dying; very dusty.

Floods.—New Corydon, Ind., 11th, violent rain; low lands flooded.

RELATIVE HUMIDITY.

The average percentages of Relative Humidity for the month ranges as follows: New England, 68 to 84; Middle Atlantic States, 60 to 79; South Atlantic States, 56 to 75; Eastern Gulf States, 71 to 76; Western Gulf States, 60 to 72; Ohio valley and Tennessee, 55 to 69; Lower Lakes, 54 to 72; Upper Lakes, 63 to 71; Upper Mississippi valley, 62 to 71; Lower Missouri valley, 65 to 67; Red River of the North valley, 68 to 73; Eastern Slope, 49 to 68; Western Plateau, 21 to 50; California, 30 to 72. *High stations* report the following averages, not corrected for altitude: Cheyenne, 33; Mt. Washington, 88; Denver, 38.5; Pike's Peak, 48; Santa Fé, 20.5; Virginia City, 48.

WINDS.

The prevailing winds, at the Signal Corps stations, are shown by the arrows flying with the wind on chart No. II. The *maximum velocities* per hour have been given in the descriptions of movements of areas of low pressure. On Mt. Washington the highest velocity, 120 miles, was recorded from the SW. on the 4th and also from the NW. on the 6th. The seven daily observations give the following results as to direction during the month: N., 18 times; NW., 92; W., 45; SW., 32; S., 15; SE., 5; E., 1; NE., 0; calm, 2

Total Movements of the Air.—The following are the *largest* monthly movements of the air recorded at the Signal Corps stations: North Platte, 12,786; Cape Lookout, 11,777; Portsmouth, N. C., 11,422; Dodge City, 11,319; Pike's Peak, 10,955; Kittyhawk, 10,577; Breckenridge, 10,297; Cape Hatteras, 10,293; Wood's Holl, 9,270; Umatilla, 8,919; Fort Sill, 8,753; San Francisco, 8,038. The *smallest* are: Florence, Ariz., 2,212; Nashville, 2,278; Silver City, N. M., 2,389; Tucson, 2,520; Lynchburg, 2,525; Visalia, 2,676; Roseburg, 2,836; Uvalde, Tex., 2,947 Indianapolis, 3,077.

Local Storms.—Salt Lake City, 6th, severe wind storm; three cars blown from track of Western Utah Railway. Violent storm in Dubuque, Ia., night of 9th; anemometer registered 60 miles when electric circuit was broken; estimated velocity, 80 miles; great damage to property; over 20 buildings unroofed. Cloud burst on Beaver Creek, near Buffalo Gap station, 92 miles south of Deadwood, Dakota, on the 12th, drown-

ing eleven persons. There was no warning by a gradual rise of the water. Rain commenced about dark and in a few minutes the whole country was said to be covered with water. The flood subsided as fast as it rose. Severe storms and tornadoes reported from Kansas on the 9th and 10th, mentioned in connection with low area No. III. From Carmi, Ill., a cyclone reported on the 10th, lasting about 15 minutes; several persons were badly injured and buildings blown down. Destructive local storms passed over southern parts of Ohio and Indiana and northern Kentucky on the 11th, doing considerable damage to crops. One railway depot demolished and trees uprooted. 24th, Des Moines, Ia., severe, with heavy rain and violent winds; many bridges carried away and great damage done to buildings and crops. Three persons were drowned. 26th, violent storm occurred in Ohio. 28th, a tornado in Baltimore, unroofed about 50 buildings and did considerable damage; no person was killed. 27th, Fort Smith, Ark., from NNW.; worst for 40 years; blew down several houses, damaged others and injured crops.

Waterspouts.—New London, Conn., 19th, moved across mouth of harbor 6 miles from station.

Sand Storm.—Visalia, 16th, severest this year.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily weather indications for June with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of omissions to be 0.8 per cent. and of verifications to be 83.9 per cent. The percentages for the four elements have been, Weather, 87 6; Direction of the Wind, 87.5; Temperature, 81.1; Barometer, 79.1. The percentages of verifications by geographical districts have been: New England, 84.9; Middle States, 86.0; South Atlantic States, 79.8; East Gulf States, 80.4; West Gulf States, 81.1; Lower Lake region, 88.6; Upper Lake region, 86.8; Tennessee and the Ohio valley, 84.9; Upper Mississippi valley, 83.3; Lower Missouri valley, 81.2; Northern Pacific coast region, 88.3; Central Pacific coast region, 93.3; Southern Pacific coast region, 95.0. Of the 3,687 predictions that have been made, 167, or 4.58 per cent, are considered to have entirely failed; 105, or 2.85 per cent, were one-fourth verified; 517, or 14.02 per cent, were one-half verified; 350, or 9.49 per cent, were three-fourths verified; 2,546, or 69.05 per cent, were fully verified, so far as can be judged from the tri-daily weather maps.

Cautionary Signals.—117 Cautionary Signals were displayed during the month, of which 103, or 88 per per cent, were justified. 15 Cautionary Off-shore Signals were displayed, which were all justified as to direction; 9, or 60 per cent, were justified as to velocity. Of the Cautionary Off-shore signals 6 were changed from Cautionary. 132 signals of both kinds were displayed, of which 112, or 84.9 per cent, were fully justified. The above does not include signals ordered at 47 display stations where the velocity is only estimated and not measured. 70 cases were reported of winds of 25 miles or over where signals were not ordered.

NAVIGATION.

Stage of Water in Rivers.—In the table on the right-hand side of chart No. III are given the highest and lowest readings of the Signal Corps river gauges for the month, with the dates. The Red River at Shreveport fell gradually throughout the month from 15 ft. 3 in. on the 1st to 4 ft. 4 in. on the 30th. The Missouri at Yankton continued between 5 ft. 5 in. and 8 ft. 3 in. from the 1st to the 19th, "when the June flood commenced" and the river rose to 12 ft. 6 in. by the 26th; at Omaha and Leavenworth the river fluctuated between 12 and 14 feet from the 1st to about the 16th, when it began rising, and reached its highest point (16 to 17 ft.) on the 27th and 28th. The Observer at Kansas City reports the first headwater rise in the Kansas river on the 15th. The Upper Mississippi, from St. Paul to Keokuk, generally fell, except a slight rise during the last few days at St. Paul; at St. Louis it rose from 13 ft. 3 in. on the 1st to 16 ft. 7 in. on the 9th, continued almost stationary until the 18th, when it began rising, reached 18 ft. 5 in. on the 22d, fell to 17 ft. 5 in. on the 25th, and afterwards rose to its highest point, 20 ft. 11 in., on the 30th; at Cairo it rose from 15 ft. 1 in. on the 1st to 18 ft. 2 in. on the 7th, fell to 16 ft. 7 in. on the 14th, rose to 18 ft. on the 24th, fell to 16 ft. 10 in. on the 26th; at Memphis it rose from 8 ft. 6 in. on the 1st to 13 ft. 4 in. on the 11th, fell to 11 ft. 2 in. on the 23rd, rose to 13 ft. 3 in. on the 26th and fell to 12 ft. 1 in. on the 30th; at Vicksburg it rose from 14 ft. 9 in. on the 4th and 5th to 18 ft. 11 in. on the 16th, fell to 17 ft. 3 in. on the 23rd, and rose to 18 ft. 3 in. by the 30th; at New Orleans the changes were slight throughout the month. The Tennessee at Chattanooga and the Cumberland at Nashville continued low and generally falling throughout month, except temporary rises at former place on the 17th and at the latter on the 16th. The Ohio remained quite lowand generally falling throughout month; temporary rises occurred at Pittsburgh on the 6th, 7th and 30th, and at Cincinnati from 10th to 13th. A temporary rise also occurred in the Savannah at Augusta from the 11th to the 13th, otherwise the water remained between 4 and 5 ft. above low water mark. The observer at Fayetteville reports (30th) navigation almost suspended on the Upper Cape Fear river, owing to very low water. The only instance where the water reached the danger point occurred at Omaha from the 25th to the 30th, when the flats were covered and railroad tracks submerged. The low water at Pittsburgh caused a suspension of navigation, except to boats of the lightest draft and the observer reported (30th) about 150 acres of coal in barges lying at that place awaiting a rise.

High Tides.—Cape Lookout, N. C., 4th, 5th.

Low Tides.—Indianola, 16th, 18th.

Tidal Wave.—Grand Haven Mich., 10th, the captain of steamer Flora reports encountering a tidal wave, about 5 a. m., when within 25 miles of west shore of Lake Michigan; the ridge of water was about 7 to 8 feet high; the rough sea reached the east shore of the Lake about 11 a. m.

TEMPERATURE OF WATER.

The *temperature of water*, as observed in rivers and harbors, with average depth when observations were taken, are given in table on chart No. II. Observations were interrupted at the following places on the dates indicated: on account of loss of thermometers, at Baltimore, 1st to 5th instant, at New London, 1st to 4th, at San Francisco, 1st to 23rd, and at Savannah, from the 19th to the 29th. The report from Baltimore, received too late for insertion in table, gives the highest temperature 76°, lowest 71°, average depth, 11 feet.

ATMOSPHERIC ELECTRICITY.

Thunder-storms.—1st, N. Y., Conn., Ill., Iowa, Me., Mass., Neb., N. H., N. J., Ohio, Vt., Col., N. M., Mo.; 2nd, Md., N. Y., Me., Mass., N. J., Ohio, Pa., Va., Conn.; 3rd, Ill., Mass., N. J., Pa., Iowa, Va.; 4th, Neb., N. Y., Mass., Mich., Pa., Vt., Wis., Wyo., Iowa, Va.; 5th, Md., Neb., N. Y., Dak., Ill., Ind., Me., Mass., Mich., N. H., N. J., Ohio, Pa., Vt., Col., Iowa, Mont.; 6th, Neb., Conn., Dak., Ill., Me., Md., Mass., N. H., N. J., Ohio, Pa., Va., R. I.; 7th, Kan., Neb., Fla., N. C., Dak.; 8th, Minn., Dak., Iowa, Mo., Neb., Pa., Kan., Ala., Fla., Tenn., Ga.; 9th, Ind. Ty., Kan., Minn., Neb., Ala., Dak., Ill., Ind., Iowa, Mo., N. Y., Ohio, Vt., Va., Wis., Tex., Fla., Ky.; 10th, Mass., Kan., Minn., Conn., Dak., Ill., Ind., Iowa, Md., Mich., Me., Neb., N. J. N. Y., N. C., Ohio, Pa., Vt., Va., Wis., Ky., R. I.; 11th, Neb., N. Y., Va., Conn., Ga., Ill., Ind., Iowa, Md., Mass., Mo., N. H., N. J., Ohio, Pa., Tenn., Vt., Kan., Dak., Ala., Mich., Ky., N. C., Me.; 12th, Neb., N. Y., Ala., Conn., Dak., Ill., Iowa, Kan., Me., Md., Mo., N. J., Ohio, Pa., Vt., Nev., Tex., Fla., Tenn., N. C., Va., R. I., 13th, Dak., Ill., Iowa, Mo., Neb., N. H., N. Y., Va., Tex., Miss., Ind., Fla., Mass.; 14th, Ala., Can., Dak., Ill., Ind., Iowa, Kan., Mich., Mo., Ohio, Wis., Col., Neb., Ind. Ty., Tex., Tenn.; 15th, Neb., N. Y., R. I., Va., Conn., Ga., Ill., Ind., Mass., Mich., N. H., N. J., N. C., Ohio, Pa., Tenn., Col., Tex., Ala., Wis.; 16th, Kan., Neb., Conn., Md., Mass., N. Y., Pa., Col., Dak., Tex., Miss., Fla., Ala., N. C., Va., R. I.; 17th, Fla., Kan., Mo., N. Y., Tex., La., Ind., Ga., S. C.; 18th, Ind. Ty., Neb., Dak., Mo., Wyo., Ind., Fla., Pa., N. J.; 19th, Ind. Ty., Kan., Neb., Dak., N. C., Va., Cal., Tex., Fla.; 20th, Ind. Ty., Ga., Iowa, Wis., Kan., Tex., Dak.; 21st, Ind. Ty., Dak., Mich., N. M.; 22nd, Mo., N. Y., Pa., Kan.; 23rd, Neb., Iowa, Dak.; 24th, Kan., Dak., Ill., Ind., Iowa, Mo., Neb., Va., Minn., Tenn., N. C.; 25th, Ala., Can., Dak., Ill., Ind., Iowa, Mass., Mo., Neb., N. J., N. C., Ohio., Pa., Va., Fla., W. Va.; 26th, Kan., N. Y., Ill., Ind., Iowa., Mass., Mich., Mo., Neb., Ohio, Pa., Vt., Dak., Ala., Fla., N. C.; 27th, Kans., Conn., Dak., Ill., Ind., Iowa, Me., Md., Mass., Mich., Mo., Neb., N. Y., Ohio, Pa., Vt., Col., Ind. Ty., Wis.; 28th, Md., Ark., Conn., Ind., Mo., Mass., Mich., Me., Neb., N. J., N. Y., N. C., Ohio, Pa., Vt., Wis., Col., Tex.; 29th, Moont., Kan., Neb., N. Y., Va., Ala., Conn., Fla., Mass., N. J., Pa., Va., Col., Tex., Ind., N. C., Ga., R. I.; 30th, Fla., Mass., Neb., N. Y., Ind. Ty., Dak., Tex., N. J.

Auroras were observed as follows: on the 7th, in Iowa, Indiana, Canada and Maine; 8th and 9th, in northern portion of New England, Michigan and Dakota; 12th, summit of Pike's Peak and in Iowa; 13th, in New England, as far south as Connecticut; 15th, in Iowa; 16th, in Missouri, at Boonville and St. Louis, latter being most southerly during month; on the 17th a marked and general display, embracing New England, part of the Middle States, Lake region, Ohio and Upper Mississippi valleys; the most southerly reports are from Urbana, Ohio, and Chambersburg, Pa. This display, though general, was faint, white and straw being the prevailing colors. Its form was generally a dark segment, surmounted by a luminous arch, from which pale beams occasionally shot upward. It appeared earliest in the Northwest, at about 9 p. m., and was not seen in New York and New England until about 10 p. m.; its disappearance occurred at about midnight, being nearly simultaneous for all stations; 18th, in southern Michigan, New England, Ohio, at Fort Whipple, Va., which latter was the most southerly station reporting; 21st, in New Jersey; 23rd, in Maine; and on the 24th in Massachusetts.

Telegraphic Communication Interfered with by Atmospheric Electricity.—Pike's Peak, Col., 5th, interrupting telegraphic communication, 16th, 29th. Santa Fé, N. M., 1st, 21st. Bismarck and Deadwook, Dak. interfering with telegraph line. Mason, Tex., 9th, 12th. Eagle Pass and Laredo, Tex., 12th, prevented working of line. Graham, Tex., 9th, 19th, interrupting telegraphic communication. Pembina, Dak., 9th, 23rd, 30th, interrupting communication. Cape May, 12th, intense on wires. Springfield, Mass., 18th. Winnemucca, Nev., 16th.

OPTICAL PHENOMENA.

Solar Halos.—2nd, Ga.; 3rd, Iowa, Oregon, Minn., N. C., Tex.; 4th, Nev., Utah, Dak., Mo., Iowa, Minn., Ill., Neb.; 5th, Utah, Minn., Ohio, Ill.; 6th, Minn., Iowa, Me., Neb., N. Y.; 7th, Minn., Neb.; 8th, Iowa, Minn., N. Y., Conn., N. J.; 9th, Conn., Mass., Ill., Me., N. Y.; 10th, Utah, Iowa, Minn., Mass., N. Y.; 11th, Ohio, N. Y.; 12th, Tex., Iowa, Minn., Ohio, N. C.; 13th, Me., Ill., Ind., Ohio, Tex.; 14th, Nev., Dak., Minn., N. Y., Me., Conn., Pa.; 15th, Pa.; 16th, Cal.; 17th, Iowa; 18th, Utah, Iowa, N. C., Neb.; Oregon, 19th, Iowa; 20th, Iowa, Wis., Ill.; 21st, Dak., Ohio; 22nd, Iowa, Ga.; 23rd, Iowa, Ohio, Ky., Tenn., Ga., Fla., Cal.; 24th, Iowa, Fla., Kan.; 26th, Iowa, Mich.; 27th, N. Y., Mo.; 28th, Tex.; 30th, Kan., Mo.

Lunar Halos.—1st, Ohio, Va.; 2nd, Tex., N. C.; 3rd, Neb., Utah, Tex., Miss., Tenn., N. C.; 4th, Oregon, Utah; 7th, Neb.; 10th, Tenn.; 12th, Ohio, Iowa; 13th, Ind.; 14th, Ill.; 23rd, Tex.; 24th, Fla., Va.; 25th, Mo.; 26th, Iowa, Ind., Fla.; 27th, Tex., Iowa, N. Y., Fla., Ohio; 28th, Ind. Ty., Neb., Utah, Tex., La., Va., Idaho; 29th, Ind. Ty., Utah, Wis., N. Y., Kan., Mo.; 30th, Ala., Wis., Fla., Kan.

Mirage.—Breckenrige, Minn., 21st; Duluth, Minn., 17th; Oswego, N. Y., 24th; Cape May, 6th.

MISCELLANEOUS PHENOMENA.

Botanical.—Pembina, Dak., 5th, lettuce and radish in market; 18th, wild strawberries ripe; 20th, asparagus and new potatoes in market. Breckenridge, Minn., 24th, wheat and oats heading. Chattanooga, Tenn., 25th, peaches ripening. Augusta, Ga., ripening, 4th, blackberries; 7th, figs; 21st, peaches and tomatoes: cotton blooming, 11th. Calistoga, Cal., wild flowers seeding 14 days later, and grapes in bloom 3 weeks later than last year. Houston, Fla., ripe, 1st, watermelons; 10th, tomatoes. Milton, Fla., ripe, 1st, peaches; 15th, apples; 20th, green corn in market. Augusta, Ill., in bloom, 21st, elder; 22nd, chestnut; 25th, corn tasseling. Manitowoc, Wis., 30th, crops look well. Prof. Hinrich, in the Iowa Weather-Service, reports the condition of the crops as follows: Corn, about 5 per cent. below average on western slope, also, in middle, north and western southwest; 5 to 10 per cent. above, down the Upper Des Moines and Raccoon and southwest to Page and Decatur counties; from 3 to 6 per cent. above between Turkey and Cedar rivers, and equal to average in the north and Middle. Whe t from 20 to 40 per cent. below average in middle east, from 10 to 20 per cent. in middle north, and on western slope, except in Plymouth Co., where grasshoppers have almost completely destroyed the crops." Hay and pasture have improved during month. Arlington, Ind., in bloom 23rd, elder. Vail, Ia., 30th, all small grain very thin, nearly all headed out, corn doing well, prairie grass very light. Nora Springs, Ia., 25th, raspberries ripening. Independence, Ia., 30th, crops looking very well. Holton, Kan., 30th, continued rain injuring wheat. Creswell, Kan., 13th, oats heading. Independence, Kan., 15th, blackberries ripe. Brookhaven, Miss., 12th, cotton blooming; corn tasseling from 7th to 26th. Clear Creek, Neb., 24th, wheat headed. Statesville, N. C., 30th, wheat and oat crops very good, cotton and corn very promising. Fayetteville, N. C., 6th, corn tasseling.

Harvesting.—Ft. Gibson, Ind. Ty., 24th, oats; Uvalde, Tex., 4th, grain; Breckenridge, Wis., 11th, hay; Wytheville, Va., 21st, wheat—grain and grass both light; Highland, Ill., 11th, first wheat; Vevay, Ind., 17th, wheat; crops excellent; Arlington, Ind., 21st, harvesting begun; Guttenburg, Ia., 26th, wheat; Ft. Madison, Ia., 26th, wheat; Creswell, Kan., 10th, harvesting begun; 29th, fall wheat cut; Independence, Kan., 9th, wheat; Fallston, Md., 23rd, wheat; Ashley, Mo., 16th, wheat; crops good; 30th, oats—yield light; Fayetteville, N. C., 5th, wheat harvesting general; crop very good; Ringgold, O., 30th, wheat crop very good; Jacksonburg, O., 9th, barley; 21st, wheat; North Lewisburg, O., 30th, harvest begun; Bethel, O., 20th, wheat—injured by fly; Wooster, O., 26th, wheat.

Rot.—Highland, Ill., slight rot in grapes appeared on 14th, but on 30th seemed to have disappeared.

Birds.—*Geese*—Cairo, Ill., 27th, wild geese going south.

Miscellaneous.—*Grasshoppers*—Winnemucca, Nev., 2nd, myriads invaded town from the north; 4th, in great numbers; 5th, a few still in vicinity; 9th, a swarm passed in easterly direction; 15th, 29th, a few seen. Salt Lake City, 2nd, reported to be in large numbers on east and west "bench lands." Yankton, Dak., 8th, dense swarms, moving SW.; 26th, moving southward. Fort Fetterman, Wyo., 14th, "myriads of grasshoppers cover ground." Clear Creek and Genoa, Neb., from 24th to 29th. Iowa, 30th, "grasshoppers have done much damage in the northwest of State, and even down to Woodbury Co." *Locusts*—Fort Stephenson, Dak., disappeared on 24th. Augusta, Ga., 19th, first appearance. Independence, Kan., disappeared on 25th. Emery Grove, Md., 20th to 23rd. Oregon, Mo., locusts continued in full force until 18th, when they began dying rapidly. Plattsmouth, Neb., appeared May 27th, and on June 11th developed to immense numbers, depositing eggs; 18th, dying of rapidly; 21st, almost disappeared. Cincinnati, Ohio, first heard, 24th. Norwalk, Ohio, 13th. Melissa, Tex., 2nd, in abundance. Coalville, Utah, 30th, flying S. and SE., very high.

Meteors.—Leavenworth, 12th, from N-NE. at elevation of 45° to 50°; in falling curved towards the NE. for about 20° and then exploded with a loud noise, scattering in all directions; appeared to be about 6 in. in diameter and was exceedingly bright. At Larned, Kan., a brilliant meteor was observed on the evening of the 18th, a few moments after sunset, remaining visible about eight or ten seconds; position 25 or 30 degrees above horizon, with "no apparent motion, consequently it must have been approching the earth directly in the line of spectators;" apparent diameter, 1½ degrees; tail irregular and nearly perpendicular to horizon, length about 20 degrees, breadth about 30 degrees. 25th, on Cut Creek, 24 miles west of Alamosa, Col., shortly before sunrise, large pear-shaped meteor "fell straight down from vicinity of Jupiter; it threw out spark plainly visible in broad daylight; seemed to strike the ground not more than half a mile away; color, pale white." It is reported that the recent earthquake at Virginia City, Nev., was not felt in the lower levels of the mines in that region.

Polar Bands.—Cape Hatteras, 17th; Wytheville, Va., 1st, 13th, 15th, 16th, 18th, 21st.

Prairie and Forest Fires.—Los Angeles, Cal., 2nd. Colorado Springs, Col., 25th; mountain fires in SW. Cape Hatteras, N. C., 24th. Summit, Col., 30th, during most of month three large forest fires have

been raging from 10 to 20 miles south of this place, and are advancing rapidly east under strong winds. Johnsontown, Va., 22nd.

Zodiacal Light.—Colorado Springs and Pikes Peak, Col., looked for each day but not observed. Lynchburg, Va., 7th, 10th, 11th, 12th, 16th. Mt. Washington, looked for each day, none observed.

Earthquakes.—*January* 8th, 1879, Amoy, China, 9.47 p. m., shock; 30th, at Colima, Mexico, between 10 and 11 a. m., strong shock, during which the fish in the lake rose to the surface in great numbers. *February* 2nd, Tokio, Japan, 10.10 p. m., shock. *April* 4th, 3.36 a. m., strong shock at Zi-Ka-wei and Nankin, China. U. S. Naval Hospital, Yokohama, Japan, *April* 9th, 2.30 a. m., light shock; 14th, 9.20 a. m., light shock; *May* 10, 11.18 p. m., light shock. The *Colonist*, published at St. George's, Bermuda, of May 28th, reports "a rather heavy shock of earthquake there on the afternoon of Sunday, the 28th?, (probably the 25th,) at 5.30 p. m. Two chimneys and walls were thrown down. Reports from St. Croix, St. John, Porto Rico, and Tortola all mention heavy shocks at those places about the same hour, at latter place a house was badly damaged." San José, Costa Rica, *May* 29th, 6.30 p. m., severe shock; 30th, 1.30 a. m., severe shock; these shocks seemed to be general throughout the Republic; in San José, Alajuela and Grecia buildings were damaged. At Puntarenas a violent thunder-storm prevailed at the hour of the first shock; light shocks were also felt at Aspinwall and Panama on the 29th. On *June* 11, earthquake shocks were felt in Canada and reported as follows: Montreal, "9.58 p. m., sharp shock felt all over city, accompanied by a sharp rattle, as of near thunder; it seemed to pass from N. to S." St. Johns, Quebec, night, "heavy shock of earthquake, accompanied by a rumbling sound."

Ocean Current.—"Lieut. Com. Crowenshield, U. S. Steamer Portsmouth, at Port Royal, May 25th, from Hampton Roads, reported having found the Gulf Stream exceptionally near the coast and running at an unusually high velocity. At Capes Lookout and Hatteras it was less than three miles from the shoals and so strong and swift as to carry the ship fifty-six miles to northeastward during a calm of fourteen hours, or at a rate of four knots per hour."

Sunsets.—The characteristics of the sky at sunset as indicative of fair or foul weather for the succeeding 24 hours have been observed at all Signal Service stations. Reports from 126 stations show 3774, observations to have been made, of which 40 were reported doubtful; the remainder 3082, or 82.6 per cent. were followed by the expected weather.

Sun Spots.—The following record of observations, made by D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent Nautical Almanac, Washington, D. C.:

Date—June, 1879.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
4th, 3 p. m....	1	5	0	0	0	0	1	5	Faculæ.
4 p. m....	0	0	0	0	0	0	1	5	Faculæ.
5th, 3 p. m....	1	3	0	0	1	3	2	8	Faculæ.
7th, 2 p. m....	0	0	0	0	0	0	0	0	
8th, 4 p. m....	0	0	0	0	0	0	0	0	Faculæ.
6 p. m....	0	0	0	0	0	0	0	0	Faculæ.
9th, 4 p. m....	1	4	0	0	0	0	1	4	Faculæ.
10th, 2 p. m....	0	0	0	0	0	0	1	1	Spot circular and well-defined.
4 p. m....	0	0	0	0	0	0	1	1	
26th, 2 p. m....	1	5	0	0	.....	.....	1	5	
27th, 2 p. m....	0	0	0	0	0	0	1	4	
28th, 2 p. m....	0	4	0	0	0	0	1	8	
30th, 2 p. m....	0	2	0	0	0	0	1	10	

Observations were also made on the 2nd at 3 p. m., 12th at 2 p. m., 13th at 2 p. m., 14th at 2 p. m., 15th at 6 p. m., 17th at 2 p. m., 18th at 3 p. m., 20th at 3 p. m., 21st at 2 and 5 p. m., 23rd at 2 and 4 p. m., and on the 24th at 3 p. m., but no spots seen at those hours. Mr. Wm. Dawson, of Spiceland, Ind., reports the following observations:—3rd, 7th, 8th, 9th, 11th, 12th, 14th, 16th, 17th, 19th, 20th, 23rd, 24th, 25th, no spots; 4th, 3 spots, one group, about half way from the centre to north edge; 5th, four spots, one quite prominent; 10th, two spots, about 9′ from east edge; 27th, fourteen spots in one group, 4 quite prominent, near centre of southeast quadrant; 29th, thirty spots, one group, 4 spots very prominent; 30th, thirty-seven spots in one large group, one spot large, part of group much compressed, one spot and large faculæ very near east edge of sun. Mr. David Trowbridge, Waterburgh, N. Y., "observed the sun on the 5th, 6th, 7th, 8th, 9th, 10th, 13th, 14th, 15th, 16th, 17th, 19th, 20th, 22nd, and 24th, no spots; 29th and 30th, a group of 3 towards the western margin; July 1st, only 2 spots in the group." Mr. F. Hess reports "at Alamosa, Col., observed sun's disc (through a grass with a power of 50) on June 2nd, 3rd, 4th, 5th, 7th, 8th, 9th and 10th and saw no spots; on the 5th at 6 a. m. distinctly saw small, perfectly round and intensely black spots about equidistant between upper and lower limb and about one-third the sun's diameter from the 2nd (following) limb,—at noon it had disappeared; on the 20th at the headwaters of Alamosa creek, about 4 p. m., saw two large oblong spots near the northeastern limb; 27th, same place, morning, two groups, upper one composed of two large spots and lower one of three smaller spots; 28th, headwaters of San Juan, eight spots in two groups and three seemed to be a number of others which his glass did not resolve into distant spots; 30th, same place, morning, eight spots in two groups. Prof. Gustavus Hinrichs, "no sun spots were seen, but the sun was examined on 12 days only." Observations were made at Fort Whipple, Va., between 10 and 11 a. m. each day, but no spots seen.

NOTES AND EXTRACTS.

The following account of the cyclone at Mauritius, mentioned in the May *Review*, is taken from *La Nature* of May 10th: "The cyclone burst on the island (Reunion) during the night of March 20th to 21st, with exceeding violence, which abated only during the forenoon of the 22nd. The barometer at 12:30 p. m. March 21st had fallen to 727 mm. (28.62 inches), one of the most marked depressions observed in a great number of years. On the morning of the 20th the mercury had already touched 759 mm. (29.88 inches). * * * * Thirty-five persons perished, buried under the ruins of their dwellings or drowned. Many were wounded. The greater part of the public buildings and private residences are more or less damaged." It further states that 21 ships, putting to sea at the instance of the Captain of the Port, were saved. Three vessels were dismantled or lost, but the crews were saved. Great damage was done to growing crops, roads, quays, &c. The cyclone raged with much less force at Manritius than at Reunion.

[*From Nature, June* 12, 1879.]

The Paris Academy of Meteorological Ascents has inaugurated the series of its ærial ascensions. The first took place at St. Mandes and the second at Arcueil on the occasion of opening the Ecole Laplace. The ascensionists propose to take photographs from the car in order to ascertain the position of the balloons and make a verification of the laws of barometric height. The original idea of this difficult operation may be attributed to Laverrier. Each of the ascents will be followed by the publication of diagrams and scientific results obtained.

[*From the American Journal of Science and Arts, July*, 1879.]

Prof. *Elias Loomis* in his eleventh paper of "Contributions to Meteorology" gives the results of his study of the winds on the summit of Mt. Washington compared with the winds near the level of the sea, and "abnormal storm paths," based upon the published records of the United States Signal Service. In the investigation of the first subject he "selected all those cases in which the direction of the wind on Mt. Washington differed at least 90° from that at each of the stations, Burlington, Boston and Portland, Me. The number of these cases was 507. Three-fifths of these occurred when the wind on Mt. Washington was from W. or NW., and over four-fifths when it was from one of the points, N., NW., W. or SW. At the same time the wind at the low stations was generally from S., SE., E. or NE." As the table and details of this work were considered too voluminous for publication, he "adopted a different standard of selection, and took all those cases in which the barometer at Portland, Me., fell as low as 29.6 inches. The total number of these cases was 89," occurring from October, 1872, to March, '77. "It is noticed that for several observations preceding the minimum pressure the surface winds generally were from S., SE., E., or NE., (assumed for convenience to be the east quarter) and that about the time of minimum pressure the wind changed to N., NW., W. or SW., (assumed for convenience to be the west quarter.) On the summit of Mt. Washington a similar change of wind is sometimes noticed, though not invariably. The average of the pressures of the centre of those low areas in which the wind on Mt. Washington changed to the east quarter was 29.47, and in which no such change occurred the average was 29.47. In a comparison of cases in which an area of low pressure passed over New England, when the barometer at Portland, Me., did not fall to 29.6 inches it was found that during the continuation of seven-eights of them the wind on Mt. Washington did not at any time blow from the east quarter. He," therefore, thinks we are justified in inferring the following conclusions:

1st. In a majority of those cases in which an area of low barometer passes over New England attended by the usual system of circulating winds at the surface stations, this system of circulating winds does not extend to the height of 6.000 feet.

2nd, When the depression of the barometer is unusually great, this system of circulating winds extends to the greatest height.

3rd, When, during the progress of an area of low pressure, a system of circulating winds reaches to the summit of Mt. Washington, the change of wind to the east quarter usually begins at the surface stations eleven hours sooner than it does on the summit of that mountain; and the change back from the east to the west quarter usually begins at the base of the mountain five hours sooner than on the summit."

In the study of the second subject he selected those cases in which storm paths deviated most from the average course, (easterly,) and separated them into two classes, one containing those cases in which the direction was most northerly and the other those in which it was most southerly. On comparing these classes the following results are arrived at: In storms moving towards the north the average course was 20° east of north; the average depression below the mean at the centre of low area was found to be 0.26 inch. greater at the last than at the first observation; the average temperature on the north side of low area was 9°.5 below the mean and on the south side 14°.7 above; the average velocity of the south winds was ten per cent. greater than that of the north winds; the average rain-fall in eight hours within the low areas was 6.89 inches. In storms moving towards the south the average depression at the last observation was somewhat less than at the first, and less than half what it was at an intermediate date; the average temperature on north side was 12° below the mean and on south side 17° above; the average velocity of the north winds was about double that of the south winds, and the average rain-fall was only 0.57 inch. In both classes the average humidity on the north side was nearly the same, but on the south side it was 88 per cent. in the former and 71 in latter. He therefore considers that "the most remarkable circumstance which characterizes these two classes of storms is the difference in the rain-fall;" "that this appears to be the general characteristic of those storms which originate near the Gulf of Mexico," and that "the south wind is warm, moist and pushes northward with great force." The principle object had in view was to determine, if possible, the

reason why these storms pursued so unusual a path. In those moving northwards the centre of low pressure moved nearly towards the centre of the rain-area, and "this coincidence seems to favor the conclusion that in a great storm the condensation is an efficient cause which controls the movements of the winds;" but in those moving southward" the storm-centre did not generally follow the rain-areas, but moved away from it," and "in these cases the facts seem to show that the rain-fall exerted no appreciable influence upon the course of the storm or upon the fall of the barometer." In several cases the sky was entirely cloudless at every station on the south side of the low area. "This evidence appears to me to show that heavy and extensive precipitation does not invariably precede the first formation of depression areas, and accompany their expansion, as has been claimed. These depression areas increased in intensity when the rain-fall was nearly zero, and while the sky on the south side was not generally overcast with clouds, but in several cases was almost entirely clear. In the United States depression areas do not generally begin with extensive precipitation, but the rain fall is a concomitant after the system of circulating winds has become pretty well established. The depression of the barometer is the result of a system of circulating winds, and the most frequent cause producing such a system appears to be two or more areas of high pressure at a considerable distance (frequently 1,400 miles) from each other. Differences of temperature and of humidity are also important agents in producing and sustaining such a system of winds. When a system of circulating winds has been formed over a large extent of country, there almost invariably results a fall of rain; and if the rain-fall is abundant, and extends over a large area, it becomes a very important agent in modifying the direction and force of the winds. The principal question still remains undecided: Why did the storms in table No. II pursue a course so nearly from south to north and those in table No. I. I a course nearly from north to south? The average course of storm paths appears to be determined mainly by the average system of circulation of the atmosphere near the earth's surface, and occasional departures of storm paths from this average track appear to be mainly due to causes which render the general movement of the atmosphere at such times different from the average movement."

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

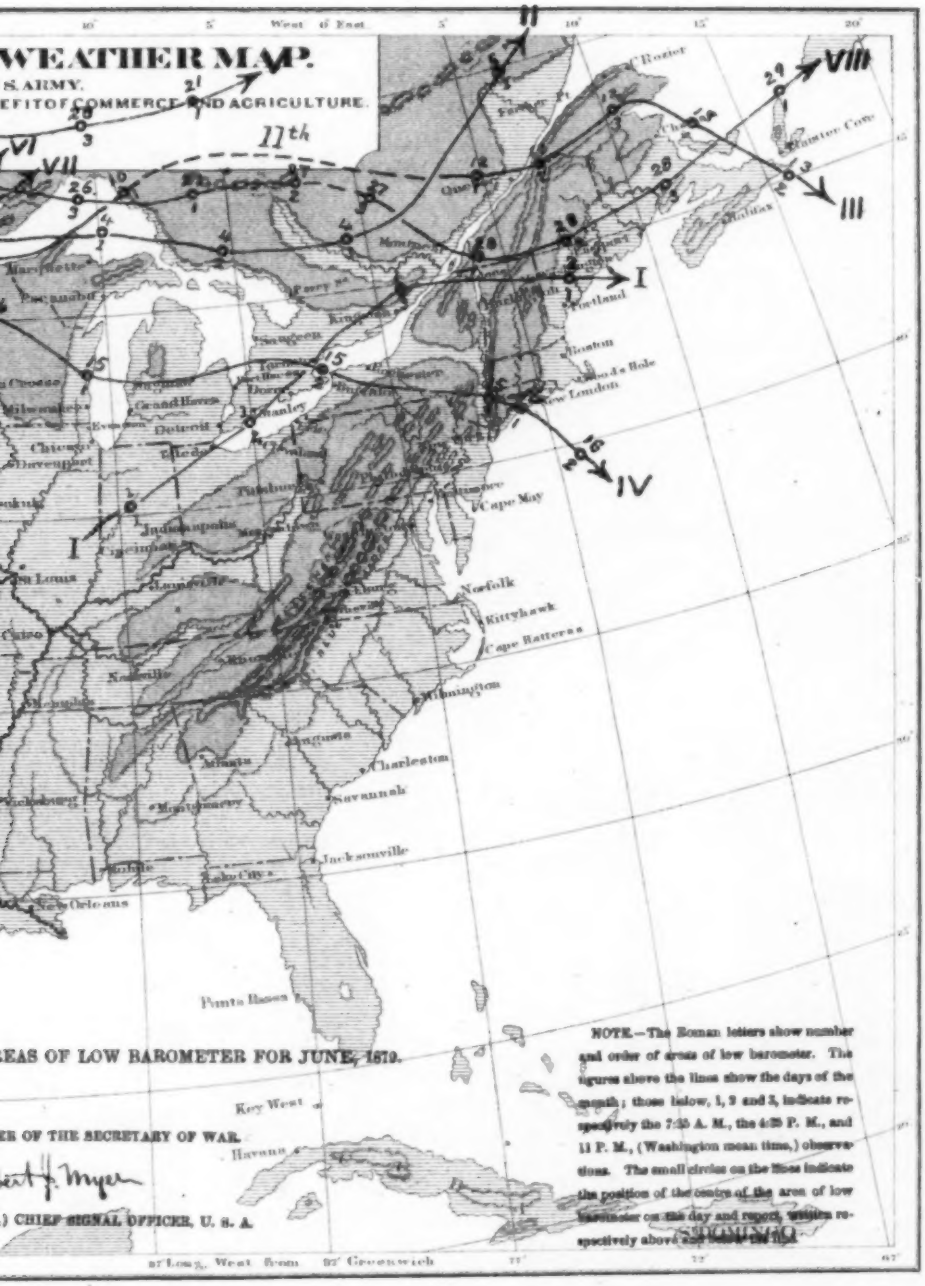
Albert J. Myer

Brig. Gen. (Bvt. Assg^d.,) Chief Signal Officer U. S. A.

Copy furnished for

WAR DEPARTMENT WEA
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF C
IV
VI
IX
III
VIII
VII
V
San Francisco
San Diego
Galveston
Indianola
AVERAGE PROGRESS OF AREAS OF LOW BAROMETER
EAST OF THE 105TH MERIDIAN.
No. | Velocity.
I. 40 miles per hour.
II. 43 do.
III. 30 do.
IV. 30 do.
V. 32? do.
VI. 27 do.
VII. 32? do.
VIII. 30 do.
IX. 27 do.
TRACKS OF CENTRES OF AREAS OF L
PUBLISHED BY ORDER OF THE S
Albert J. M
BRIG. GEN., (BVT. ASSG'D,) CHIEF SIG

No. I.



EAS OF LOW BAROMETER FOR JUNE, 1870.

NOTE.—The Roman letters show number and order of areas of low barometer. The figures above the lines show the days of the month; those below, 1, 2 and 3, indicate respectively the 7:35 A. M., the 4:35 P. M., and 11 P. M., (Washington mean time,) observations. The small circles on the lines indicate the position of the centre of the area of low barometer on the day and report, written respectively above and below the line.

ER OF THE SECRETARY OF WAR.

) CHIEF SIGNAL OFFICER, U. S. A.

TEMPERATURES OF WATER FOR JUNE, 1879.

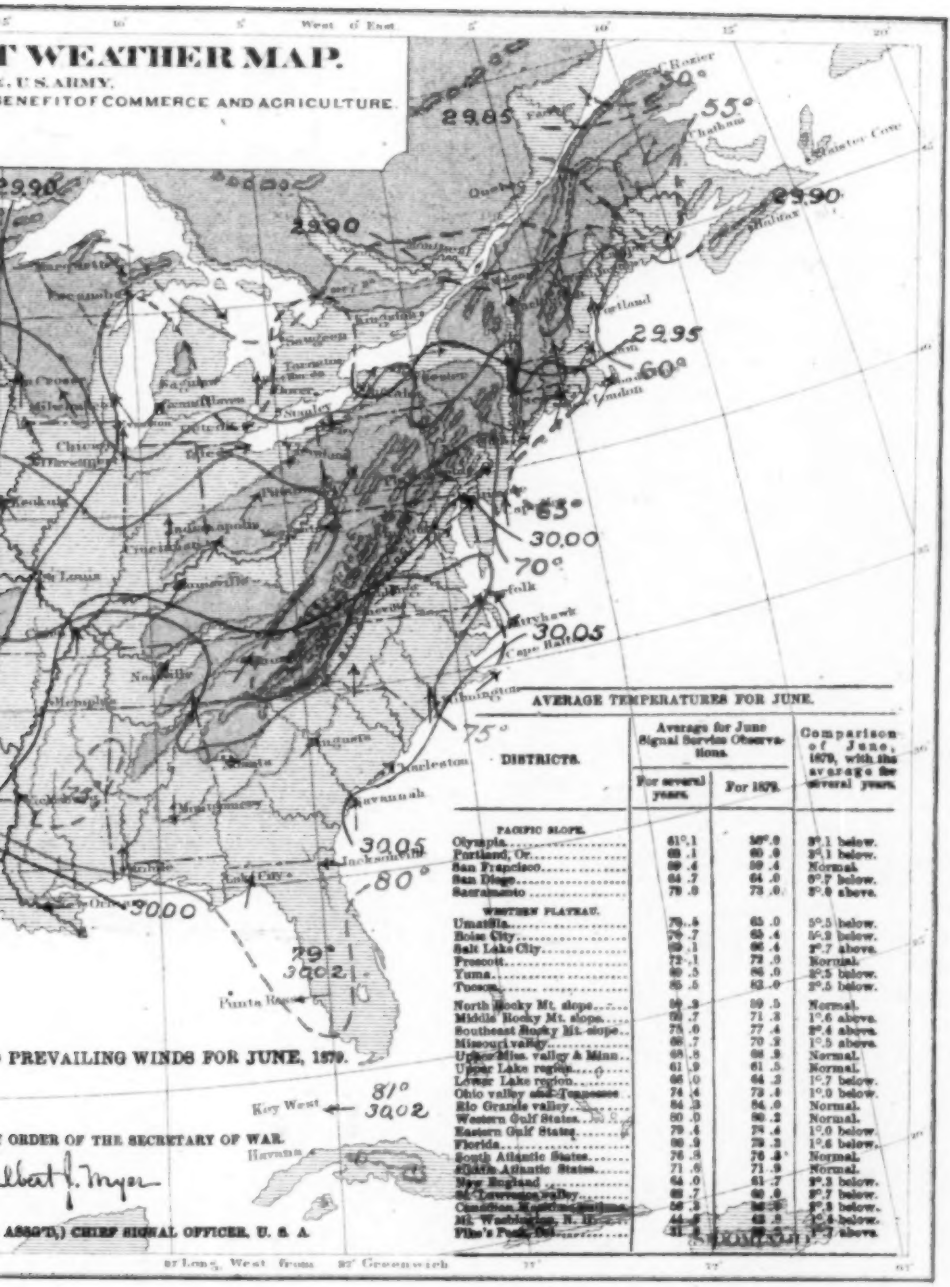
STATIONS.	Temperature at 8 o'clock. Max.	Min.	Average depth of water, in feet.
Alpena	75.5	60	21
Augusta	80	60	4½
Baltimore	—	—	—
Buffalo	73	58	14
Burlington, Vt.	68	47	19
Charleston	82	73	44
Chicago	82	58	6
Cleveland	71.5	60	13
Detroit	71	59	23
Duluth	63	38	10½
Eastport	66	46	10⅛
Escanaba	68	46	10
Galveston	86.5	75	14
Grand Haven	75	55	19
Jacksonville	86	73	18
Key West	89	80	17
Marquette	65	44	18¾
Milwaukee	73	55	15
Mobile	88	74	16
*New London	76	52.5	13⅝
New York	79	68	15⅝
Norfolk	79	73	22
Portland, Maine	73	48	20
Punta Rassa	90	80	12
San Francisco	69	53	24
*Sandusky	77	63	10
St. Marks	87.5	71	12
*Savannah	86	72	11
Toledo	74	57	9⅜
Wilmington	80	77	13¾
Wood's Holl	70	53	8

* Observations for only part of month—see text.

T WEATHER MAP.

, U.S. ARMY.

ENEFIT OF COMMERCE AND AGRICULTURE.



PREVAILING WINDS FOR JUNE, 1879.

ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

ASSG'T.) CHIEF SIGNAL OFFICER, U. S. A.

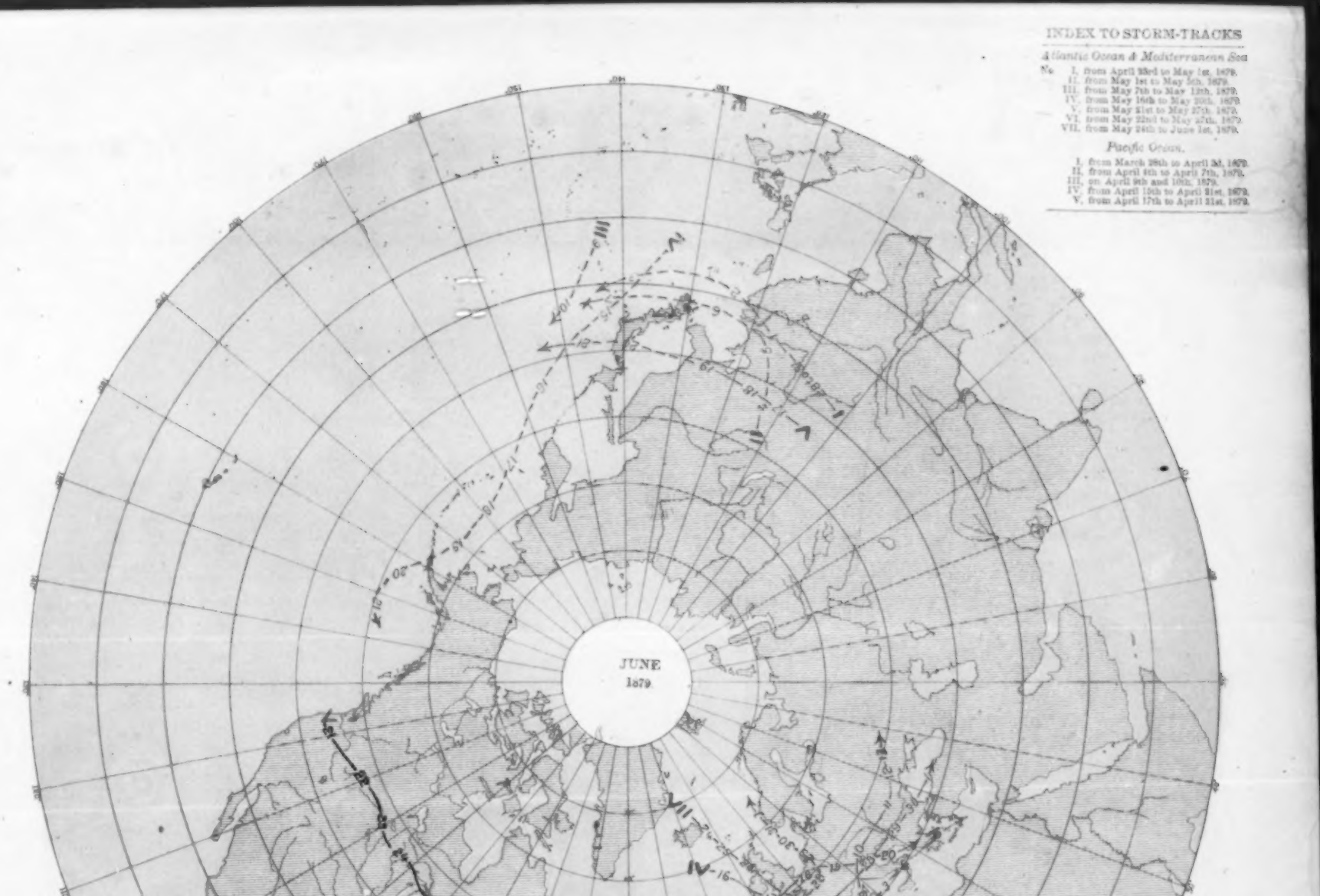
AVERAGE TEMPERATURES FOR JUNE.

DISTRICTS.	Average for June Signal Service Observations. For several years.	Average for June Signal Service Observations. For 1879.	Comparison of June, 1879, with the average for several years.
PACIFIC SLOPE.			
Olympia	61°.1	56°.0	5°.1 below.
Portland, Or.	68 .1	60 .0	8°.1 below.
San Francisco	59 .4	59 .4	Normal.
San Diego	64 .7	64 .0	0°.7 below.
Sacramento	79 .0	73 .0	6°.0 above.
WESTERN PLATEAU.			
Umatilla	70..5	65 .0	5°.5 below.
Boise City	79 .7	65 .4	5°.3 below.
Salt Lake City	69 .1	66 .4	2°.7 above.
Prescott	72 .1	72 .0	Normal.
Yuma	89 .5	86 .0	3°.5 below.
Tucson	85 .5	83 .0	2°.5 below.
North Rocky Mt. slope	89 .2	89 .5	Normal.
Middle Rocky Mt. slope	70 .7	71 .3	1°.6 above.
Southeast Rocky Mt. slope	75 .0	77 .4	2°.4 above.
Missouri valley	68 .7	70 .2	1°.5 above.
Upper Miss. valley & Minn.	68 .8	68 .9	Normal.
Upper Lake region	61 .9	61 .5	Normal.
Lower Lake region	66 .0	64 .3	1°.7 below.
Ohio valley and Tennessee	74 .4	73 .4	1°.0 below.
Rio Grande valley	84 .3	84 .0	Normal.
Western Gulf States	80 .0	80 .2	Normal.
Eastern Gulf States	79 .4	78 .4	1°.0 below.
Florida	80 .9	79 .3	1°.6 below.
South Atlantic States	76 .8	76 .8	Normal.
Middle Atlantic States	71 .6	71 .9	Normal.
New England	64 .0	61 .7	2°.3 below.
St. Lawrence valley	63 .7	60 .0	3°.7 below.
Canadian Maritime Provinces	56 .3	52 .8	3°.5 below.
Mt. Washington, N. H.	44 .6	42 .9	1°.6 below.
Pike's Peak, Col.	31 .4	32 .9	1°.7 above.

WAR DEPARTMENT WEA
SIGNAL SERVICE, U.S.ARM
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF C
PRECIPITATION CHART FOR JUNE,
Ft Benton
Portland
San Francisco
Cheyenne
North Platte
Omaha
Denver
Pike's Peak
Santa Fe
Fort Riley
San Diego
Prescott
Little Rock
Memphis
Vicksburg
Galveston
Indianola
0.63
Brownsville
PUBLISHED BY ORDER OF THE SECRET
Albert J. Myer
BRIG. GEN., (BVT. ASSG'D.) CHIEF SIGNAL
AVERAGE PRECIPITATION FOR JUNE.
DISTRICTS
Average for many years.
Comparison of June, 1879, with the average for many years
St. Lawrence valley ..... 2.47 3.26 excess.
New England ..... 3.26 4.84 1.48 excess.
Middle Atlantic States ..... 3.70 3.74 Normal.
South Atlantic States ..... 4.80 2.52 1.68 deficiency.
Eastern Gulf States ..... 5.65 4.07 1.58 deficiency.
Western Gulf States ..... 3.79 2.39 1.40 deficiency.
Tennessee ..... 5.14 2.59 2.55 deficiency.
Ohio Valley ..... 4.48 4.59 Normal.
Lower Lake region ..... 2.90 3.35 0.45 excess.
Upper Lake region ..... 3.65 3.40 0.25 deficiency.
Upper Mississippi Valley ..... 4.65 3.40 1.25 deficiency.
Minnesota ..... 4.70 3.43 1.27 deficiency.
Lower Missouri Valley ..... 5.70 7.00 1.30 excess.
Upper Missouri Valley ..... 4.68 5.15 0.47 excess.
California Coast ..... 0.12 0.06 Normal.
Portland, Or ..... 2.97 2.53 Normal.

No. III.

WEATHER MAP.
U.S.ARMY.
NEFIT OF COMMERCE AND AGRICULTURE.
R JUNE, 1879.
Scale of Shading.
0 to 2 inches
2 " 4 "
4 " 6 "
6 " 8 "
Over 8 "
HEIGHT OF RIVERS ABOVE LOW-WATER MARK, JUNE, 1879.
STATIONS.
Danger point on gauge.
HIGHEST WATER.
LOWEST WATER.
Date.
Height.
Date.
Height.
Shreveport
Yankton
Omaha
Leavenworth
St. Paul
La Crosse
Dubuque
Davenport
Keokuk
St. Louis
Cairo
Memphis
Vicksburg
New Orleans
Pittsburg
Cincinnati
Louisville
Nashville
Chattanooga
Morgantown
Pittsburg
Montgomery
Punta Rassa
Key West
Havana
Cape May
Kittyhawk
Cape Hatteras
Charleston
Savannah
Augusta
Jacksonville
Mobile
Vicksburg
Memphis
Nashville
Louisville
Cincinnati
Pittsburg
Chicago
Milwaukee
Detroit
Toronto
Kingston
Ogdensburg
Montreal
Quebec
Portland
Boston
New London
Cape May
Cape Hatteras
Key West
Havana
Punta Rassa
THE SECRETARY OF WAR.
SIGNAL OFFICER, U. S. A.
Long. West from Greenwich
Index high water marks of 1874


INDEX TO STORM-TRACKS
Atlantic Ocean & Mediterranean Sea
No. I. from April 23rd to May 1st, 1879.
II. from May 1st to May 5th, 1879.
III. from May 7th to May 13th, 1879.
IV. from May 16th to May 20th, 1879.
V. from May 21st to May 27th, 1879.
VI. from May 22nd to May 27th, 1879.
VII. from May 24th to June 1st, 1879.
Pacific Ocean.
I. from March 29th to April 3d, 1879.
II. from April 4th to April 7th, 1879.
III. on April 9th and 10th, 1879.
IV. from April 15th to April 21st, 1879.
V. from April 17th to April 21st, 1879.
JUNE
1879

INTERNATIONAL METEOROLOGY—OCEAN STORM-TRACKS.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

BRIG. GEN., (BVT. ASSG'D,) CHIEF SIGNAL OFFICER, U. S. A.

Data, as appearing in the International Bulletin of similar date.

Isobars in black exhibit atmospheric pressure at sea-level, and are charted from data as reported by the several observers.

Isotherms in red exhibit temperature of air, similarly charted.

Broken or dotted lines indicate that the lines so broken are doubtful.

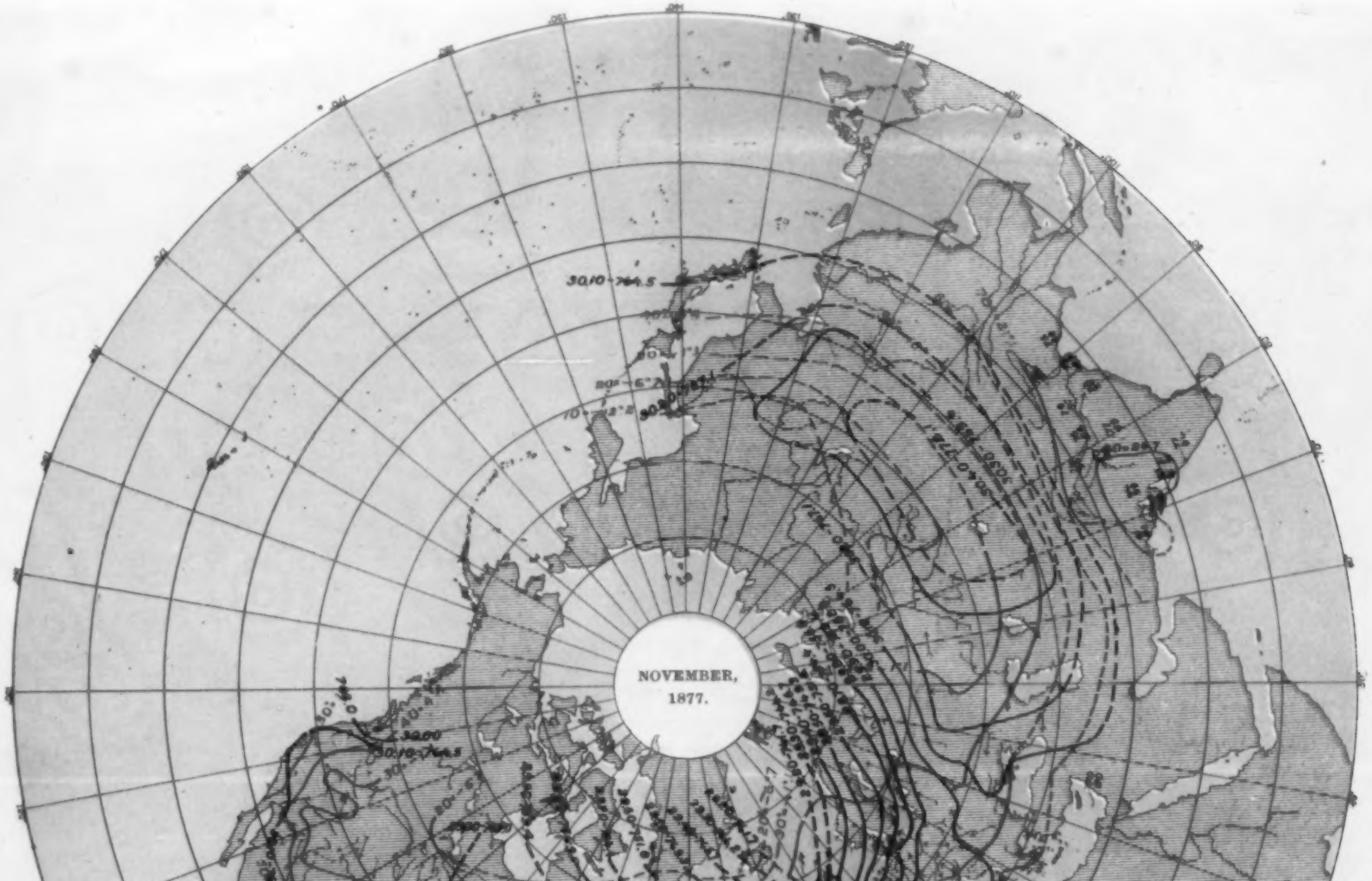
Arrows, when charted, fly with the wind and exhibit wind-direction and force.

The tracks charted in black have appeared in previous *Reviews*.

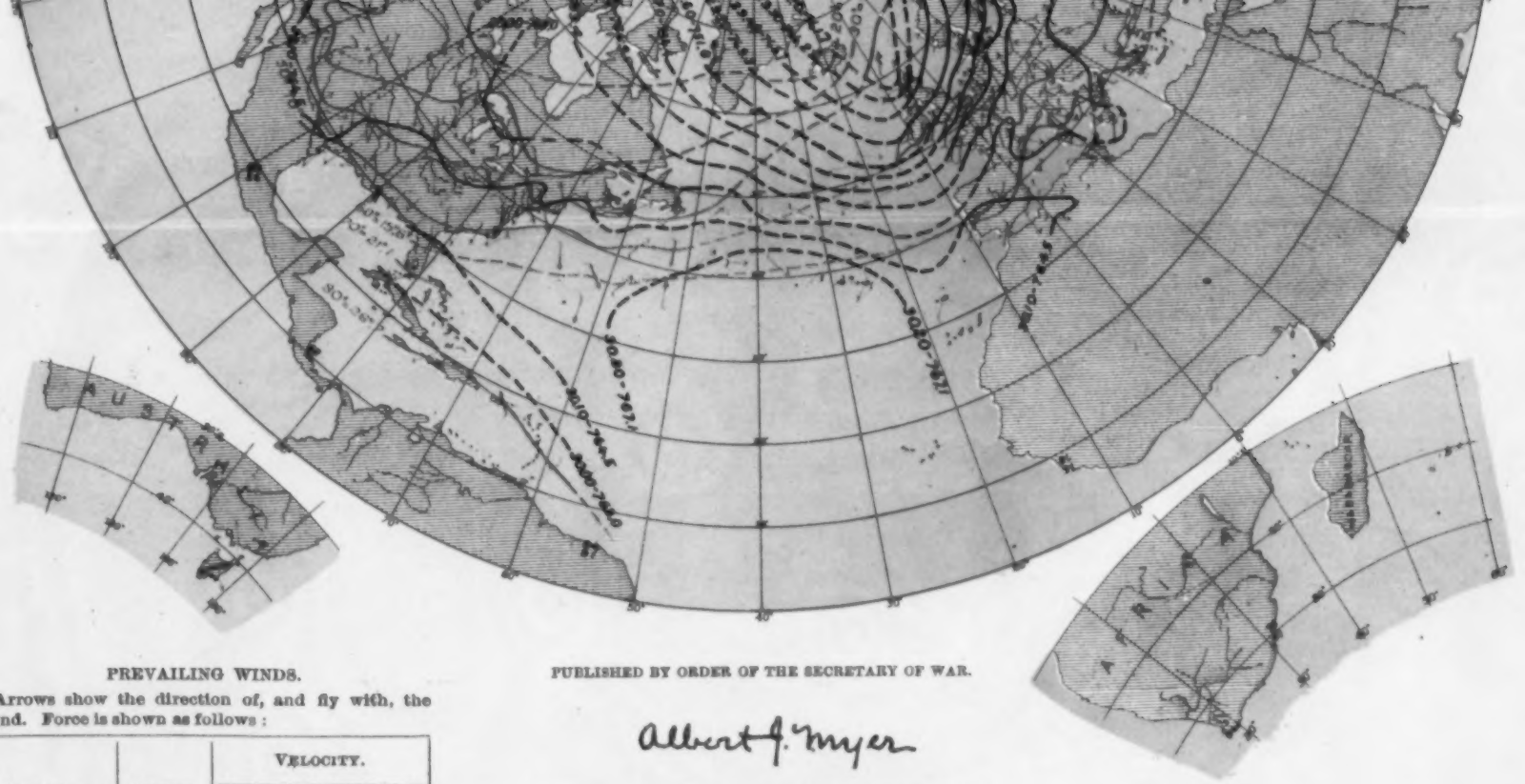
The tracks charted in red have been made from data collected since preceding *Review*.

THE HELIOTYPE PRINTING CO. 220 DEVONSHIRE ST. BOSTON.

Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of November, 1877, based on the daily charts of the International Bulletin.



PRINT IN BINDING



PREVAILING WINDS.

Arrows show the direction of, and fly with, the wind. Force is shown as follows :

SYMBOLS.	FORCE.	VELOCITY.	
		Miles per hour.	Metres per second.
→	1, 2	0 to 9	0 to 4.0
→	3, 4	9.1 to 22.5	4.1 to 10.1
→	5, 6	22.6 to 40.5	10.1 to 18.1
→	7, 8	40.6 to 67.5	18.1 to 30.2
→	9, 10	67.6 up	30.2& over

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

BRIG. GEN., (BVT. ASSG'D,) CHIEF SIGNAL OFFICER, U. S. A.

THE HELIOTYPE PRINTING CO. 330 DEVONSHIRE ST BOSTON.

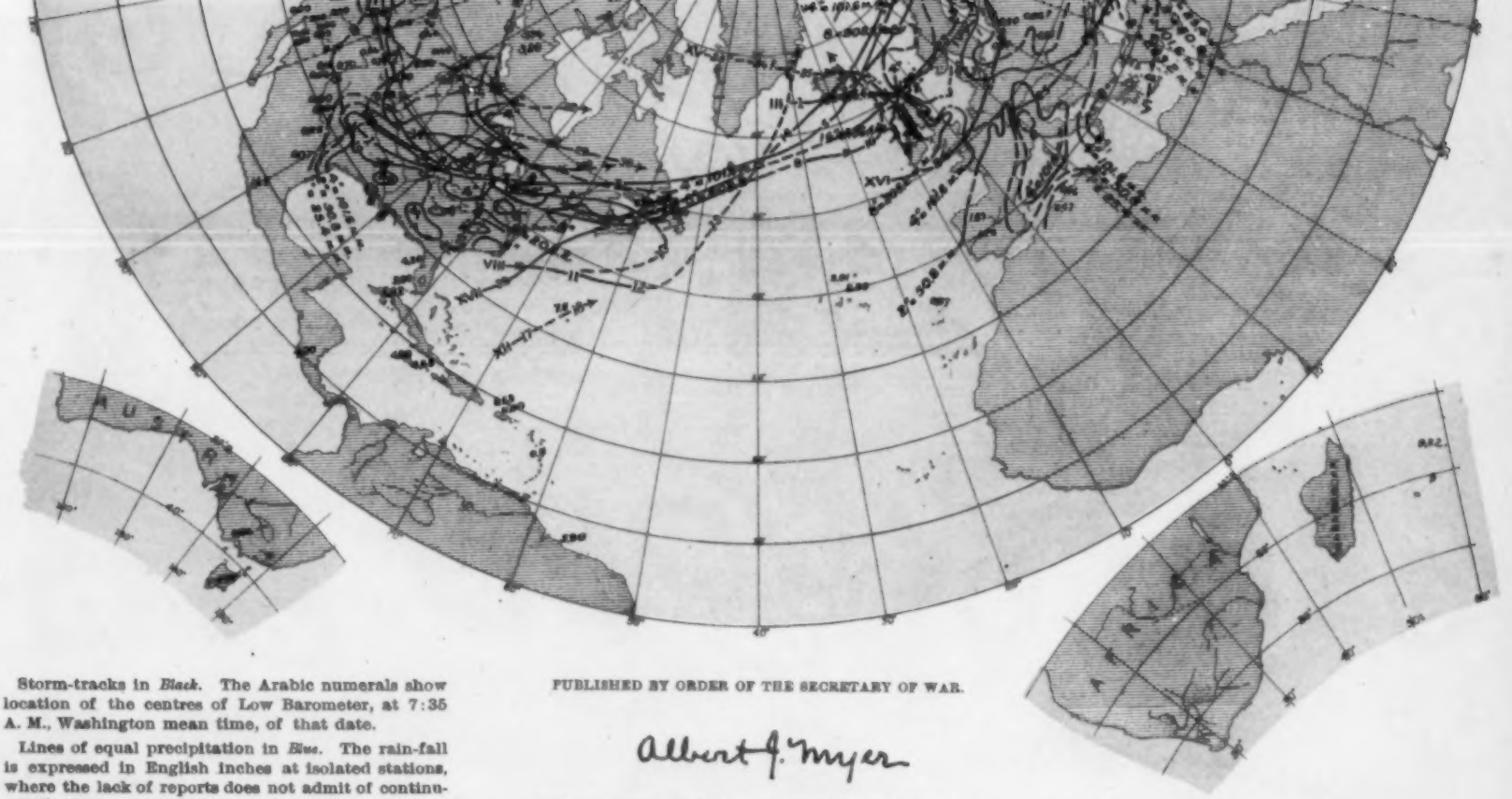
ISOBARS AND ISOTHERMS.

Isobars in *blue;* detached barometer means in English inches.

Isotherms in *red;* detached temperature means in degrees Fahrenheit.

INTERNATIONAL CHART.

Showing Tracks of Centres of Low Barometer, and Precipitation Lines, for November, 1877.



Storm-tracks in *Black*. The Arabic numerals show location of the centres of Low Barometer, at 7:35 A. M., Washington mean time, of that date.

Lines of equal precipitation in *Blue*. The rain-fall is expressed in English inches at isolated stations, where the lack of reports does not admit of continuous lines.

Broken or dotted lines are doubtful.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

BRIG. GEN., (BVT. ASSG'D,) CHIEF SIGNAL OFFICER, U. S. A.

THE HELIOTYPE PRINTING CO. 220 DEVONSHIRE ST. BOSTON.